THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XI.—No. 265.

THE INSTITUTE OF PATENT AGENTS.

In our other columns will be found the inaugural address of Mr. J. H. Johnson, the President of the above Institute, and there will also be observed the objects for which this new association has been formed. In the presence of the pending and very necessary legislation for the revision of the Patent Laws, we look upon this co-operation of patent agents as a decided step in the right direction. As Mr. Imray, the Vice-President, very truly remarked in the course of his speech, there are a thousand little things in the practice of the Patent Laws which an institute, speaking with authority as a responsible body, can compass, when no individual patent agent can do anything. This gentleman also thinks that the great difficulty which arises from the way in which the certificates of allowance for patents are issued from the offices of the Solicitor-General and Attorney-General might be rectified by such an institute, and he moreover stated that the Council was busily engaged with this very object.

But leaving such matters for consideration at a future time, we cannot but think that as far as the inventing, manufacturing, and speculating public is concerned the formation of the Patents Agents' Institute has been carried out at a most opportune moment. Probably at no period have inventions been so numerous as at the present day, and certainly we have never before had such pressing need of scientifically and legally skilled agents to correctly carry out the ideas of inventors. Many a promising idea has been spoiled by the clumsiness, indifference, or ignorance of the agent to whom the inventor had intrusted the outcome of his brain.

There are many who prefer to act as their own agents, when they have originated some scheme worthy of protection by letters patent. This we do not believe to be either an economical or wise transaction, leaving alone the amount of worry and extra work entailed. When a man has devised something he desires to patent, it is better and cheaper for him, in the end, to have his invention set forth in strict and proper terms by some reputable agent who knows exactly how much to express and what to leave out. Therefore, speaking in our particular province only, we say that the Institute of Patent Agents will be found a most useful association, and its promoters will deserve well of inventors.

We shall know that its members are men of knowledge, scientifically and legally, and that they are certificated as being competent to discharge the duties intrusted to them.

A great advantage attached to an amalgamation of professional men of any description is the opportunity afforded of clearing up any doubtful points connected with patent claims by discussions amongst themselves.

We could point out one well-known patent containing one claim only (it originally had 30) on which probably more difference of opinion exists than on any other which has gone before.

Up to the present time the patent agents have had no such advantage as this we have mentioned appertaining to other professions, but now all obscure points can be thoroughly ventilated and correct decisions arrived at.

We trust that the Council will be always on the alert to keep from the body of the Institute those whose claims to the title of patent agent are considered at all doubtful, and then the respectable members of the profession and the public too will reap a mutual benefit.

W. T. HENLEY.

We have lost in the person of Mr. Henley, whose untimely and sudden death we recorded last week, one of the earliest pioneers, and probably the most energetic worker in electrical science. His career was a most remarkable one, and gives us another example of what dogged perseverance and an undaunted spirit may achieve in the face of difficulties which would dishearten and crush the majority of men. He was fond of relating his experiences, in a modest and diffident manner, to those in any way connected with him, and his biography would form one of the most interesting subjects we can conceive in relation to matters electrical.

The space at our command will not allow us to produce more than a brief outline of his chequered experience, a subject on which we have conversed with him many a time and oft.

Mr. Henley was born at Midhurst, in the County of Sussex. After receiving a fair education, he was brought up by his grandfather and his uncle, who were leather-dressers, to that trade, but not liking the business, at 16 he left the country to seek his fortunes in London. He began as a light porter at a silk mercer's in Cheapside, and afterwards worked in the docks as a labourer for some five years. Meanwhile he taught himself the use of tools, and fitted up in the single room which he occupied, a bench made with his own hands, vices, throws, &c.; and morning and evening, before and after the work of the day, he successfully manufactured philosophical and electrical instruments, which were placed in a shop close at hand (a chemist, we believe), for sale. He thus attracted the attention of scientific men, and morning and evening, before work, and after work tired with the heat and burden of the day, young Henley pushed on in the endeavour to reach the goal of his ambition.

At twenty-four years of age, being a dexterous workman in electrical apparatus, he was employed by Professor Wheatstone when developing his telegraph, assisting in Wheatstone's experiments and gaining an extended acquaintance with electrical science.

When the first Electric Telegraph Company was formed Mr. Henley did a large amount of work for them in instruments, but having partially executed a large order for the company, which they for some reason cancelled, he went to law with them, and they resolved to give him no more work. He then invented his magnetic telegraph and formed a powerful company, who purchased the patent for £68,000 in cash and shares.

It is related how, when hindered by the old Electric Telegraph Company, who had possession of all the railways, and had obtained a monopoly for overhead work, from erecting

competitive wires, Mr. Henley retorted by digging trenches and laying underground wires from London to Carlisle, and from Dublin to Belfast. When the Government took over the telegraph lines of the country, Mr. Henley's Company was, of course, included.

He afterwards built the telegraph works, 12 acres in extent, at North Woolwich, and made submarine cables one after another, employing for this purpose upwards of 2,000 men. He manufactured about 14,000 miles of submarine telegraph cables, the greater portion of which he also laid. Finding that purchasing his wire placed him at a disadvantage in competition, he laid down the machinery and plant for drawing his own wire at the North Woolwich Works. After a time this led to a works in Wales for making the wire rods, and later on sheet iron. Still later Mr. Henley essayed the galvanising and corrugating of iron at North Woolwich.

For some years he was extraordinarily successful, and then from reasons not necessary to mention here the North Woolwich works were reduced to a very small part of their original extent, and operations have since been carried on by a company formed for the purpose of taking over the business.

Latterly Mr. Henley's name has been before the public in connection with his patent ozokerited india-rubber core, of which we have tested some hundreds of miles, and have on various occasions spoken favourably of its valuable properties. He was also engaged in perfecting a system of dynamo-electric machines and lamps for electric lighting when so suddenly taken from his earthly labours.

Mr. Henley's rough, but genial presence, will be keenly missed by the poorer inhabitants of North Woolwich, for his charitable deeds, although hidden from the world at large, were continuous to the deserving, and it is also to be feared to the undeserving, who could so readily impose upon his simple and generous nature.

Mr. Henley, who died at the age of 68 from congestion of the lungs, brought on by a chill caught only a week before, was interred in Kensal Green Cemetery on Monday last, in the presence of numerous and sympathetic friends.

ELECTRICAL EXHIBITIONS.

By W. H. PREECE, F.R.S.

(Paper read before the Society of Arts, on Wednesday, the 13th inst.)

EXHIBITIONS and displays of the practical applications of science to the useful wants of man have been cropping up during recent years with marvellous rapidity and fecundity. They owe their origin chiefly to the great Loan Collection of Scientific Apparatus, which was held at South Kensington during the latter six months of 1876. This was the first real electrical exhibition. In the Great Exhibition of 1851, one of the thirty classes into which the exhibition was divided, was devoted to "Philosophical instruments, and processes depending upon their use," and a small subdivision of this class was devoted to Magnetism and Electricity. Here we had mariners' compasses, electric telegraphs—then in their infancy, the application of electro-magnetism as a motive-power—still in its babyhood, the electric light—well matured even then, electric clocks, therapeutic applications, and electrotype apparatus. Here was shown the first submarine cable, Dr. Joule exhibited his great electro-magnet, and Hjorth the Dane—the foreshadower of the electro-dynamic system—showed his early attempt to obtain motive-power by electro-magnetism, but the show was small, and only really interesting in the telegraphic branch; and I think it was here that the Chairman of our Council received his first public award in England, for the very fine exhibit his firm (Siemens and Halske) made, and which richly earned a Council medal. In 1851, electricity played but a very minor part. In the next Exhibition of 1862, great progress had been made, and though the same classification was adopted as in 1851, the electrical subdivision was very much larger. An extremely able report on the electrical instruments displayed was written by Professor Fleeming Jenkin. Improvement and progress were still confined to telegraphy; but, in the meantime, submarine cables had become practical and commercial undertakings. The Atlantic had been spanned, and a very strong stimulus had been given to scientific research, from a practical point of view. Sir William Thomson had brought his brilliant intellect to bear on this virgin soil, and the result had been that the Exhibition of 1862 denoted very great progress in invention and constructive skill, and displayed a numerous and excellent assortment of electrical appliances for other purposes than telegraphy. For instance, the electric light was one of the attractions of the place. Duboscq and Serrin, of Paris, Jaspar, of Liege, and Holmes, showed their arc lamps in operation. The magneto-electric machine and lamp of the last exhibitor had been working at the Dungeness Lighthouse from the previous year to the year 1875. Holmes' machine still works the South Foreland and Soutar Point lighthouses under the care and management of our excellent Trinity House. I remember very well an electric engraving machine and an electric loom at the 1862 Exhibition.

In 1871 we had another International Exhibition, chiefly associated in our memories with the loss of the founder of the great Exhibition of 1851, and our own much revered President. It was not a success, and I can find no record of the exhibition of any striking electrical novelty. It was not comparable with the Exhibitions of 1851 and 1862, and it was not followed by any such valuable report as that of Professor Fleeming Jenkin on the Exhibition of 1862.

There were great and successful International Exhibitions held in Paris in 1867 and 1878. The latter was epoch marking, for though electricity formed but a very small subsection, it was the occasion when Jablochkoff lighted up the Avenue de l'Opéra, and produced such a consternation among gas shareholders. The Pavilion, illuminated by him, was one of the striking features of the show. Here, also, we saw the great developments made in the electro-dynamic machine by Gramme and Siemens.

At Vienna, in 1873, a very successful exhibition took place noteworthy for being the occasion when Fontaine first showed the capital experiment of transmitting power by electricity. A gas-engine moved a dynamo-machine (the generator), which turned another dynamo-machine (the motor), 1,000 metres off, that worked a centrifugal pump.

Philadelphia, the Great Centennial Exhibition of 1876, is celebrated for Bell's great experiment of transmitting or rather reproducing speech by electricity. It was here that Sir William Thomson heard Shakespeare quoted through an ordinary telegraph wire by means of "the greatest by far of all the marvels of the electric telegraph."

There was an Industrial Exhibition in Berlin in 1879, which is interesting from the fact that here Siemens worked the first tramway by means of electricity, carrying eighteen persons.

The first electrical exhibition was that of 1876. In the previous exhibitions electricity played a small subsidiary part—here it came into prominence and took the leading place. It was intended to display scientific apparatus employed for teaching and for investigation, and also such as possessed historic interest on account of the persons by whom or the researches in which they had been employed. It became also a very fine exhibition of the practical applications of electricity. It was international in its character, though not in its design. A very large number of exhibits were sent from abroad. It was supported by the most eminent physicists and scientific men on the continent. Abroad, it obtained a reputation it never reached at home. It was most unfortunate in its title. "The Special Loan Collection of Scientific Apparatus" was not attractive. The press, for

some unaccountable reason, decried it. The general public shunned it, and though 213,196 people visited it, it never acquired the popularity then, which it certainly would acquire now, if it were held again, and given a more telling title. But such priceless treasures as were brought together there will never be brought together again. The catalogue and publications issued by it form a small library. There was not only an admirable catalogue—one of the best ever compiled—but a handbook of short descriptive essays, written by such men as Clerk Maxwell, Clifford, Spottiswoode, Tait, Carey Foster, Norman Lockyer, Geikie, Huxley, and others equally eminent.

There were 1,404 exhibitors, of whom 761, more than half, were foreigners, derived from the following sources :—

United Kingdom	643
Austro-Hungary	46
Belgium	18
France	116
Germany	378
Holland	33
Italy	47
Norway	9
Russia	70
Spain	14
Switzerland	30
	1,404

The number of objects exhibited was about 13,000. There was held, in its earlier days, also a conference of scientific men, at which 110 papers were read, and which brought together an average attendance of seventy persons. There were no less than fifty-three evening lectures, to which admission was free, and at which the average attendance was 425. At these conferences and lectures explanations and demonstrations were made of the method of using and employing the various instruments exhibited. The historical portion of the exhibition was the richest of its class that has ever been held. Notwithstanding all this, the exhibition fell dead, and it is now but little remembered. It came before its time.

The Electrical Exhibition of Paris, of 1881, was more fortunate. Owing to the excitement consequent on the activity of electric light promoters, and of the startling invention of the telephone, the public had become interested in electricity. The title, "electrical exhibition," was attractive, and the energy and enterprise of M. Cochéry, the Minister of Posts and Telegraphs, brought together very strong support from other nations. Hence the Paris exhibition became, in every sense of the word, an "international electrical exhibition." Here we saw every nation vying with each other to see how the electric current could, economically, supplant gas as a domestic illuminant. Here we saw, for the first time, Edison's solution of the problem, and the progress made by his great English rival, Swan. Here we saw Duboscq, Serrin, Jaspar, and Siemens, with their experiences since 1851, indicating the progress they had made during the past thirty years. Again, we saw telegraphs moulded by experience, invention, and practice into fine race-horses, compared to the heavy dray-horses of the former period. In 1851, it was scarcely possible to send twenty words a minute; here we saw 200 words a minute transmitted as a matter of course. Only one message could be sent on one wire in 1851; in 1882, two, four, six, and eight messages were shown in transit simultaneously, on one wire. The telephone had sprung into existence. Music was transmitted from the opera, and the words spoken on the stage were distinctly heard a mile or more away. Boats were propelled by electricity upon a small lake, and ploughs were moved, printing machines worked, balloons gyrated about in the air, sewing machines rotated by currents of electricity produced a long way off. Here again, we saw how electricity can be employed to give instant warning of fire, and by-the-bye, how few there are who avail themselves of this useful and valuable application. Not only can we, by merely touching a button, raise an alarm of fire in the police-station or in the fire-engine station, but we can make the fire itself, in its early stages, automatically raise an alarm, and practically say, "Here I am burning away nicely and merrily in the library, will nobody come and put me out?" In the face of the terrible fire that London witnessed last week, it is hoped that some attention will be given to this most beautiful application of electricity, which was so fully shown in Paris and subsequent exhibitions.

The Paris Exhibition produced no striking novelty. It illustrated, rather, progress. New methods, new combinations, new applications were numerous, but absolute novelties were absent. It however showed the practical man to be ahead of the philosopher, and illustrated the fact that in the case of electricity the science owes more to practice than to theory. Unlike the exhibition of 1876, the press, especially the *Times*, met the want of the public, by publishing very full and able reports of the work done and descriptions of the things shown. The exhibition was also the occasion of the meeting of a very important congress of electricians of all countries, at which numerous questions were discussed, but at which the most important was the establishment of a uniform system of electrical measurements. In this field of measurement there was no deep-seated *inch* to brush aside, nor time-honoured *shilling* to drive into oblivion, but the coast was comparatively clear. The quantities to be measured were little known, few had been working on the question, and therefore the difficulties to surmount were not many. The necessity, however, for a uniform system of standards, and a universal system of nomenclature was paramount, and hence a coherent system was proposed, accepted, and universally adopted with wonderful celerity. This speedy adoption was the most striking proof of its necessity. Men wanted to know how much electricity they were using to produce given effects, how much electricity was the result of certain mechanical operations, how much electricity could be conveyed to a given distance by a given wire. Moreover, as electricity was the result of mechanical motion, it was clear that there must be an intimate connection between motion and electricity. And as all motion involves *time* and *space*, and mechanical motion *matter* also, so electrical measurements must be based on mechanical ones. Hence the centimetre as the unit of space, the gramme as the unit of mass, and the second as the unit of time, have been taken as standards, and the system is therefore called the C.G.S. system of units. Now we have in electricity, *electromotive force*, that determines its flow; *resistance*, that opposes this flow; and *current*, the flow itself. But electricity can also be stored up in a kind of caged condition, ready to burst out into lightning, or to flow out gently, "to waft a sigh from Indus to the Pole." It is then held prisoner by induction, the magnitude of which is measured and expressed by the term *capacity*. Now, a unit of electricity is called a *coulomb*, and if this unit, under the influence of a unit electromotive force, flows for one second through unit resistance, it produces a current of one *ampère*. The standard resistance is called an *ohm*, while the standard electromotive force producing the flow is called a *volt*. If this coulomb so produced were stored by induction, then the capacity of the configuration maintaining it would be called a *farad*. The capacity of a conductor is thus measured by the quantity of electricity it will hold, as a cask is measured by the quantity of wine it holds.

The ohm can be represented by a column of mercury 1·0615 metres long of a square millimetre section at 0° Centigrade.

The volt is very nearly the electromotive force of a Daniell cell.

An ampère is very nearly the current required to maintain an 18-candle glow * lamp alight.

A farad is too large for practical purposes. So we take a millionth part of it, and call it a *microfarad*, which is the capacity of about three miles of an Atlantic cable.

Some idea of the quantity of electricity involved in electric lighting may be gathered from the fact that it would require 3,000,000 miles of the Atlantic cable—an area of seventeen and a-half square miles—to hold the quantity of electricity that passes through each lamp in this room in each second of time. It is comparable to the charge contained in a thunder-cloud before it bursts out in lightning. For a cloud offering three square miles area at a moderate height—say, 100 feet—the charge would not be more than one coulomb.

* I accept this term "glow," proposed by Dr. Siemens. Glow lamps are sometimes called "incandescent," sometimes "incandescence"; the latter is the more correct, but the less euphonious. Glow is equally correct, far more euphonious, and more in accordance with the spirit of the age.

Now, when electricity flows through resistance, it does work upon the matter through which it flows. Hence heat is produced, and hence glow. Now, this work done depends upon the current flowing and on the electromotive force present. If we multiply the electromotive force by the current, we have a measure of the energy expended. Hence one volt × one ampère = one watt, which is the unit of electrical work. Seven hundred and forty-six watts equal 1 horse-power; so that we have a very ready means of converting the expression for electrical energy into that of mechanical power, and *vice versa*. Each glow lamp in this room is worked by 105 volts, and ·8 ampère, or it requires an absorption of 84·0 watts, something less than one-tenth of a horse-power per lamp. Now all these units, except the watt, were chosen by the Electrical Congress at Paris, in 1881, and they have been accepted by all the world. This is the great result of the Paris Exhibition, and that which will mark it as an epoch in the history of electricity.

The success of the Paris Exhibition led to an imitation of it at the Crystal Palace in the early part of the year. As a practical and popular exhibition, the result was undoubtedly a success; but it was mainly a commercial undertaking, and could not in any real sense be called international. It followed the Paris Exhibition too quickly. There was a very fair display of electrical appliances; over 300 exhibitors sent things there; but it was chiefly as an electric light exhibition that it will be remembered. Telegraph instruments and bells, telephones, and cable grapplers were mixed up too much with toys, weighing machines, and toilet commodities to give it a scientific character. As a practical demonstration of electric lighting it left nothing to be desired, but as an event marking scientific progress it must soon be forgotten. A new exhibition, in which gas plays a prominent feature, opens there to-day, with what prospect of success I cannot say.

(*To be continued.*)

ON THE APPLICATION OF ELECTRO-MOTIVE POWER TO MARITIME PURPOSES.

By A. RECKENZAUN, C.E.

(*Continued from page* 472.)

THIS force will propel a screw launch having a displacement of about three tons, at the rate of nine miles per hour. The cost of each cell depends upon the material, mode of manufacture, and the maker's profit combined. I shall, however, be asked, How much does it cost to charge the cells; or, what is the expense of filling them and re-filling them with electrical properties? This I must reply will depend upon a number of circumstances—for instance, upon the place and the method adopted for the purpose of generating the electric force requisite therefor: if we have water-power or wind at our disposal, it will cost next to nothing; while, if we must depend upon steam-power, we must take the cost of the fuel at the particular locality into account. This cost of fuel also depends in great measure upon the economy and construction of the boiler, furnace and engine utilised. A good condensing engine will not consume one-half the amount of coal which a small, but good launch-engine would, and since the efficiency of our whole electrical apparatus will be more than 50 per cent., we may safely assert that the electromotive power will not be *more* expensive than steam-power for our boat.

Hence the application of electricity to the propulsion of *small* vessels is not only possible, since we have just demonstrated that fact; but it is also commercially advantageous.

In order, however, that electric-launches may come into general use, it will be necessary to establish stations at which the batteries may be charged and re-charged; on the banks of our larger rivers there will be little difficulty in finding the required force, and a small dynamo is all that is needed for the purpose: we may even make use of the motor itself to produce the charging current, if we find a motive-power, from whatever source this power may be procured.

Turning now from the peaceful launch we may proceed to direct our attention for a moment to the warlike torpedo-boat.

Numerous are the peculiar qualities demanded in a boat of this description, and this species of craft requires the most delicate management, as well as the utmost skill and ingenuity on the part of him who designs, builds, or equips it for service. No expense is spared to secure the fulfilment of all the requirements necessary to a perfect torpedo-boat, and this class of vessel has of late played quite as important a part in naval engineering as any other—not excepting the ironclad. To make this boat invisible to the enemy has been the study of some engineers, to impart to it the highest possible speed the ambition of others; while to make it noiseless, to prevent the emission of smoke or vapour-clouds from its machinery are most essential points with all who wish to render it perfect. All of these can be secured by the employment of electric-power for their propulsion, and I venture to think that in course of time it will entirely displace steam on board of torpedo-boats. The noise of an electro-motor is no greater than that of a well-oiled, well-fitted revolving cotton-spindle, and can scarcely be heard at the farther end of the vessel; having neither smoke nor steam another of the greater difficulties is obviated. Speed has a limit in the steamboat just as in the electric-boat. Electrical machinery is far more easy of management than steam machinery, for one man can just as quickly and with as much ease turn on or off and regulate the current of several hundred accumulators as he could press the button of an electric bell, while very little skill or practice are required in handling the different portions of the apparatus.

Now to prepare a *steam* torpedo-boat for service is a serious affair; steam must be got up hours before it can start; three sets of stokers and three engineers must be constantly in attendance to attend upon and watch the fickle-minded concern: while, on an electric-vessel, the accumulators can always be in readiness; one turn of the switch-handle suffices to start it; and it will then require no further care or attention, except to steer it, until it arrives at its destination, which, in most cases, will be in a short space of time. The electro-motors, batteries, and accessories will, of a necessity, come below the water-line—for it would be difficult to place them above—protection is thus obtained from the shot of an enemy, so far as the propelling machinery is concerned, and in a greater degree, by reason of its smaller size, than for that of the steamer. But, besides propelling the boat, the accumulators are as capable of other duties as the steam-engine, such as steering her, lifting the anchor, &c., while, in addition, they can do what the steam-engine alone cannot, viz., throw an intense light upon any particular place or object, and fire the gun if there be one on board.

These are in brief and roughly noted the most elementary yet important points; more minute details I must leave to the specialist.

One more use to which this motive-power might successfully be applied in time, in connection with naval affairs, is, I think, in the steam-launches carried on board many of the larger men-of-war for the landing of armed parties and the heavier guns for shore duties; and for other purposes when, in case of danger or other sudden emergency, a small or light-draught and swift vessel is required at short notice. How much handier and readier would not an electric-launch be, with its power ever at the command of the moment, without notice, without hurry or anxiety?

The next small craft of importance is the ferry-boat; one without oars, without sails, without a towing-chain and without a boiler—a floating bridge on which the passengers need not be suffocated by smoke nor drenched with the greasy, condensed exhaust-steam, nor besmeared by the black, dusty remnants of imperfect combustion. Powerful ferries must be provided where the traffic demands them; but in very many instances the traffic is great only at certain hours of the day—perhaps four or six runs bring the bulk of the day's passengers and goods—yet when, as hitherto, there is no alternative to steam, the fires must be kept up in the boilers and the attendants retained on duty between times, and during the far greater number of hours in which the ferry is but seldom required. Such a ferry-boat, if propelled by electricity, is constantly ready so long as there remains a charge in the accumulators—and the loss of

charge while at rest amounts to less than one per cent. during a whole day's work—yet no attendance is needed, until the moment arrives to start; and then the one man who starts and stops the machinery can also with facility steer as well: so that, were it not for the mooring at the piers, no other person would be required to assist. Just as the captain of the Woolwich ferry at this moment may be touching the button to ring the signal bell for starting, stopping, or reversing the engine, so he might with no greater exertion himself, direct the whole machinery, if worked by electricity in place of steam, from the bridge, by simply touching the handles or buttons of the switches which convey the current. By two small instruments near these handles he could at any time inform himself of the state of his motive-power, and see at a glance what current there is, and what electro-motive force. He would need no longer to tremble at the possibilities of mistakes on the part of his engine-driver or fireman; and the safety of his passengers would be proportionately increased as the number of "hands" in charge was decreased; for the captain can sooner reverse his apparatus himself than he can correct a wrongly-understood command in the moment of danger.

I may mention that in some instances of ferry propulsion it would be an easy matter to dispense entirely with batteries on board, if found more convenient, as we could convey the current from shore to the machine on board by either a submarine cable or an overhead wire, thus connecting the generator and the receiver by any convenient means. Instead then of carrying the weight of the cells we could use merchandise as ballast and save freightroom at same time.

The electric tug-boat will in many ways prove superior to the steam-tugs, since it is more easily managed, not so liable to get out of order, and, during the long intervals of waiting outside the bar of the harbour for the ship to tow into port, the maintenance will be cheaper.

As for the passenger traffic in the tropics, those who have experience of steamers on Indian waters may best be able to give an opinion. The steam boiler and machinery in such circumstances have often been described as intolerable accompaniments of travel in those countries. Not to dwell upon the discomfort to travellers of the close proximity of the engine-room; firemen fainting and dropping dead in the stokehole through the effect of the excessive heat is a daily occurrence. Every possible precaution is taken to relieve these poor sufferers as far as can be—ventilators are placed in every part of the ship; but the air, already hot, affords but little appreciable relief; the exhausted, half-nude fireman rushes up the ladder every few minutes for a breath of the outer air, and runs down again to attend to the furnaces and safety valves of his boilers, suffering the utmost agony; and the most robust men are soon rendered prostrate with hardly a remedy. The swift revolving armature of our electro-motor, on the other hand, agitates the air in its vicinity, and the sensation when standing near it resembles that caused by the gentle wafting of the zephyr by a lady's fan.

Having thus far given a very rough and general outline of the advantages afforded by the employment of electricity in the continuous propulsion of small vessels, I venture to proceed to indicate in brief a few other possible adaptations of this subtle force to the purposes under review. Commencing again with pleasure-boats, which play no small part in the industries of maritime nations, I may be permitted to suggest the application of electric energy to the auxiliary propulsion of sailing-yachts. Yachting is probably one of the most interesting sports to an Englishman; but how often is he caught in a dead calm and exposed to the dangers and involuntarily at the mercy of the silent mirror on lake or bay, or surprised by sudden squalls, when every sheet must be stowed, and he is compelled to "lie to" under bare poles, completely at the mercy of the waves, till the fury of the storm has passed, scarcely able, from the lightness of his craft, to keep her "head to wind"? He may well desire to move, if only at the rate of a few yards an hour. How often is he caught on a lee-shore in either calm or tempest—the tide setting landwards, and his only hope of safety the "making a good offing"? An auxiliary steam-engine and a prosaic boiler with its unsociable attendant would at once destroy the poetry, the beauty, cleanliness, and comfort of a fairy yacht, the very suggestion would almost be deemed a mockery and an offence by an enthusiastic yachtsman. A funnel to a sprightly, smart, and trim sailing-yacht would in his eyes seem worse than a sailor in spurs. On the other hand, a small dynamo and a set of secondary cells under the cabin-floor would at once serve the purpose of the usual stone or iron ballast, be out of the way, invisible, harmless, and still in an emergency be handy, ready for use, certain to act on the moment, and of vital importance to life and property. To propel a yacht by a small screw a few miles per hour would involve a small expenditure of force; but a force available or not at will, without preparation and requiring in use no skilled "hand," and not even wounding the *amour-propre* of a sportsman nor blemishing the good name of his craft.

For sailing-ships making long voyages I could not, in the present almost experimental state of this subject, recommend auxiliary electric propulsion—the dead calm may last longer than the stored force; nevertheless, there are several ways in which electric-power may be usefully and economically applied on board even a large sailing vessel—ways in which steam on such ships cannot offer the same advantages at a similarly low cost. The steering of a large vessel when under full sail, going any usual speed, is a matter of hard work, often too hard for muscular power available when a heavy gale is blowing: on such occasions steamers can resort to their steam-steering gear, which a child could manage; but the sailing-vessel must do as best she can with manual labour, which often can be but ill-spared, in sufficient strength, from other important duties in a storm. Mechanical power would be of great advantage and the only such power which, without elaborate and lengthy preparation, we can bring to bear, which we can conveniently store, and that will give us a great force for a short time is electricity. The batteries could be shipped fully charged and the used-up energy replenished at odd hours by manual labour when the "hands" are comparatively idle—often during a calm or a long spell of fair wind, in real want of exercise. A windmill would effect our purpose and could be hoisted at convenient times to drive a dynamo on board. This electric energy once introduced on a ship would be available for many things — weighing anchor, furling sails, driving the winches in small ports where steam cranes do not exist; for pumping, should she spring a leak; and also — perhaps mainly—for lighting purposes. The advantage of lighting ships by electricity has already been admitted and the method adopted on several of the principal steamship-lines; but accumulators are only now being resorted to, experience having proved that these batteries are indispensable to the *successful* carrying out on any large scale of electric lighting.

Whatever may happen to the steam-machinery, whether it be temporarily disabled or at rest in harbour, the secondary batteries on a steamer so equipped continue to supply the light for many hours with certainty and economy. In hot countries the ventilating fans would be driven by this same apparatus in harbour and at sea.

Other uses to which this friendly, harmless force might be applied will readily suggest themselves to you; but, having enumerated the most important, I will not dwell upon further details.

In conclusion, I would observe that, although electricity may be for many purposes economically employed, there seems to me to be little hope as yet that it will quite supplant steam in those operations requiring the highest degree and development of power—such as, among others, ocean navigation.

ELECTRIC BELLS AND SIGNALS AT HER MAJESTY'S MILITARY PRISON, LANCASTER CASTLE.—Since this castle was converted into a military prison great inconvenience has been experienced by the mechanical signals from each cell being unworkable, also from the chief warders having no means of signalling to each other in case of need. Mr. Sharples, electrician, of Preston, was instructed to arrange a system of electric signals. This has been done and the work completed; a somewhat difficult task, as the walls were in many places 3 yards thick. Over 90 of the cells have each an electric bell push, so made and arranged that the prisoners cannot damage them. All communicate with an indicator in the chief warder's office, and the different warders' offices are connected with each other by electric bells.

APPROXIMATIVE PHOTOMETRIC MEASUREMENTS OF SUN, MOON, CLOUDY SKY, ELECTRIC, AND OTHER ARTIFICIAL LIGHTS.

By Sir WILLIAM THOMSON, F.R.S.

THE author pointed out that the light and heat radiated from hot bodies were but the different modes in which the energy of vibration induced by the heat was conveyed to our consciousness. A hot kettle, red-hot iron, incandescent iron, platinum, or carbon, the incandescence in the electric arc, all radiate energy in the same way, manner, and according as it is perceived through the sense of sight, by its organ the eye, or by the sense of heat*, we speak of it as light or heat. When the period of vibration is longer than one four hundred million millionth of a second the radiation can only be perceived by the sense of heat; when the period of vibration is shorter than one four hundred million millionth of a second, and longer than one eight hundred million millionth of a second the vibration is perceived as light by the eye.

Pouillet, from a series of experiments, has deduced a value of the energy radiated by the sun as equal in British units to about 86 foot-pounds per second per square foot at the earth's surface, or about 1 horse-power to every 6½ square feet of the earth's surface. We estimate from this the value of the solar radiation at the surface of the sun. The sun is merely an incandescent molten mass losing heat by radiation and surrounded by an atmosphere of incandescent vapour, so that the radiant energy really comes out from any square foot or square mile of the sun's surface as from a pit of luminous fluid, which we cannot distinguish as either gaseous or liquid. Take, however, instead of the sun an ideal radiating surface of a solid globe of 440,000 miles radius. The distance of the earth being 93,000,000 miles, the radius of the sun is equal to, say, in round numbers, 1-200th of the earth's distance; hence the area at the earth's distance, corresponding to 1 square foot of the sun's surface, is equal to 40,000 square feet. The radiation on this surface is (40,000 × 86 or) 3,440,000 foot-pounds, which is therefore the amount of radiation from each square foot of the sun's surface. This amounts to about 7,000 horse-power, which, according to our brain-wasting British measure, we must divide by 144 if we wish to know the radiation per square inch of the sun's surface, which we thus find to be 50 horse-power.

The normal current through a Swan lamp giving a twenty-candle light is equal to 1·4 ampères with a potential of 40 to 45 volts. Hence the activity of the electric working in the filament is 61·6 ampère-volts or Watts (according to Dr. Siemens' happy designation of the name of Watt, to represent the unit of activity constituted by the ampère-volt). To reduce to horse-power we must divide by 746; and we then find about one-twelfth of a horse-power for the electric activity in a Swan lamp. The filament is 3½ inches long and ·01 of an inch in diameter of circular section; the area of the surface is thus 1-9th of a square inch, and therefore the activity is at the rate of ¾ of a horse-power per square inch. Hence the activity of the sun's radiation is about 67 times greater than that of a Swan lamp per equal area.

In this country the standard light to which photometric measurements are referred is that obtained from what is known as a standard candle. Latterly, however, objections have been raised against its accuracy. It has been said that differences of as much as 14 per cent. have been found in the intensity of the light given by different standard candles, and that serious differences have been observed in the intensity of the light from different parts of the same candle in the course of its burning. The Carcel lamp, the standard in use in France, has been regarded as the only reliable standard. It is, no doubt, very reliable and accurate in its indications, but it should be remembered that its accuracy is greatly owing to the careful method and the laborious precautions taken to secure that accuracy. If something akin to the precautions applied to the Carcel lamp by Regnault and Dumas were applied to the production and use of the standard candle, there is little doubt but that sufficient accuracy for most practical purposes could also be obtained with it; probably as good results as are already obtained by the use of the Carcel lamp.

At the Conference on Electrical Units which met in Paris lately, a suggestion was made to use as a standard for photometric measurements the incandescence of melting platinum, and very interesting results and methods in connection with the proposal were presented to the meeting.

For approximative photometric measurements the most convenient method is certainly that of Rumford, by a comparison of the shadows cast by the sources of light on a white surface. The apparatus necessary are only a piece of white paper, a small cylindrical body such as a pencil, and a means of measuring distances. Ordinary healthy eyes are usually quite consistent in estimating the depth of shadows, even when the shadows examined are of different colours, and with a reasonable amount of care photometric measurements by this method may be obtained within 2 or 3 per cent. of accuracy. The difference in the colours of the shadows is of course due to each shadow being illuminated by the other light.

Arago has compared the luminous intensity of the sun with that of a candle and estimates it as equal to about 15,000 times that of a candle flame.

Seidel, as the author has been informed by Helmholtz, estimated the luminous intensity of the moon as about equal to that of grayish basalt or sandstone. An experiment on sunlight, made in Glasgow on the 8th of this month (since this paper was read), compared with an observation on moonlight, which the author made at York during the meeting of the British Association there, in 1881, has led him to conclude that the surface of the moon radiates something not enormously different from one-third of the light incident upon it. The observation on moonlight referred to above showed the moonlight at the time and place of the observation (at York early in September, 1881, about midnight, near the time of full moon) to be equal to that of a candle at a distance of 230 centimetres.

The luminous intensity of a cloudy sky was found about 10 a.m. one day in York, during the meeting of the British Association, to be such that light from it through an aperture of one square inch area is equal to about one candle. The colour of its shadow, compared with that from a candle, was as deep buff yellow to azure blue: the former shadow being illuminated by the candle alone, the latter by the light coming through the inch hole in the window-shutter.

The experiment on sunlight of last Friday (8th December) showed, at one o'clock on that day, the sunlight reaching the author's house in the University, to be of such brilliancy that the amount of it coming through a pin-hole in a piece of paper of ·09 of a centimetre diameter produced an illumination equal to that of 126 candles. By cutting a piece of paper of such shape and size as just to eclipse the flame of the candle and measuring the area of the piece of paper, he found about 2·7 square centimetres as the corresponding area of the flame. This is 420 times the area of the pin-hole and therefore the intensity of the light from the sun's disc was equal to (126 × 420) about 53,000 times that of a candle flame. This is more than three times the value found by Arago for the intensity of the light from the sun's disc as compared with that from a candle flame.

* Sometimes wrongly called the sense of touch. The true list of the senses first given, I believe by Dr. Thomas Reid, makes two of what used to be called the sense of touch, so that instead of the still too common wrong-reckoning of five senses, we have six, as follows:—

Sense of Force.
" Heat.
" Sound.
" Light.
" Taste.
" Smell.

PROFESSOR A. G. BELL'S EXPERIMENTS.—We are indebted to the courtesy of Professor A. G. Bell for advanced proofs of a most interesting paper read before the American Association for the Advancement of Science, in August last, and which we commence in our following pages.

UPON THE ELECTRICAL EXPERIMENTS TO DETERMINE THE LOCATION OF THE BULLET IN THE BODY OF THE LATE PRESIDENT GARFIELD;

And Upon a Successful Form of Induction Balance for the Painless Detection of Metallic Masses in the Human Body.*

By ALEXANDER GRAHAM BELL.

(A paper read before the American Association for the Advancement of Science, at the Montreal Meeting, August, 1882.)

The subject of my present paper recalls a time of intense excitement and painful suspense. The long, weary struggle with the untimely death-wound—the prolonged suffering borne so bravely and well by the lamented President Garfield—must still be fresh in every recollection. The whole world watched by his bed-side, and hopes and fears filled every passing hour. No one could venture to predict the end so long as the position of the bullet remained unknown. The bullet might become safely encysted, but, on the other hand, recovery might depend upon its extraction. The search with knife and probe among vital and sensitive tissues could not be otherwise than painful and dangerous; and the thought naturally arose that science should be able to discover some less barbarous method of exploration.

Among other ideas the thought occurred that the bullet might produce some sensible effect in modifying the field of induction of a coil brought near the body of the President, and that the locality of the bullet might thus be determined without danger to the patient and without pain; for it is well known that induction can be powerfully exerted through the human body without producing any sensation whatever.

Upon the balancing of Induction.

The influence that is exercised upon induction by metallic masses has formed the subject of numerous experiments by different investigators; and the principle of balancing the effects of induction on one portion of a circuit by equal and opposite effects produced upon another portion has been utilised in nearly all such investigations.

The earliest form of induction balance for this purpose appears to have been devised in Germany by Prof. Dove,† about the year 1841, and a good description of it in the English language may be found in De la Rive's "Treatise on Electricity" (1853 edition, Vol. I., pp. 418-433).‡

Another and superior arrangement for the same purpose is the well-known induction balance of Prof. D. E. Hughes.§

The static induction balance of J. E. H. Gordon,‖ though primarily intended for experiments upon specific inductive capacity, might also, perhaps, be employed in the same class of investigations.

My own attention was directed to the balancing of induction a number of years ago by the disturbing noises produced in the telephone by the operation of telegraphic instruments upon lines running near the telephone conductor.

The difficulty was remedied by using two conductors instead of one, and by so arranging them with reference to the disturbing wires that the currents induced in one of the telephone conductors were exactly equal and opposite to those induced in the other. In this way an induction balance was produced and a quiet circuit secured for telephonic purposes. This method was patented in England in November, 1877, and during the whole winter of 1877-8 I was engaged in London upon experiments relating to the subject.

In the course of these researches I made frequent use of flat spirals of insulated wire, like those employed by the late Prof. Henry * in his experiments upon induction.

My method was to pass a rapidly interrupted voltaic current through one flat spiral while I examined its field of induction by means of another flat spiral connected with a telephone. The currents induced in the latter coil produced a musical tone from the telephone.

At every point in the field of induction it was found that by turning the plane of the exploring coil a position of silence could be obtained, and another of maximum sound, the two positions making a right angle with one another.

It was also noticed that when a position of silence was established a piece of metal brought within the field of induction caused the telephone to sound. This effect was most marked when the two flat spirals were in close proximity, and were arranged with their planes parallel, as shown in fig. 1.

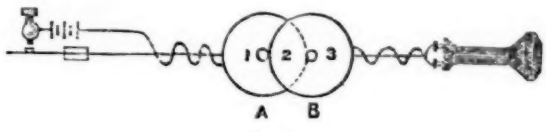

Fig. 1.

When a silver coin, such as a half-crown or florin, was passed across the face of the two coils, the silence of the telephone was broken three times. The instrument emitted a musical tone when the metallic disc passed the points marked 1, 2, and 3 in the illustration, but the loudest effect was produced when the coin crossed the area marked "2," where the two coils overlapped.

After my return to America I embodied these and other results in a paper "Upon New Methods of Exploring the Field of Induction of Flat Spirals," which was read before this association at the Saratoga meeting in August, 1879.

Practical Application.

While brooding over the problem of the detection of the bullet in the body of President Garfield, these experiments made in England returned vividly to my mind. It seemed to me that if the overlapping area, "2," of the two coils shown in fig. 1 could be brought over the seat of the bullet without disturbing the relative positions of the coils, the telephone would probably announce the presence of the bullet by an audible sound.

A crude experiment was at once made to test the idea. A large, single-pole electro-magnet (the core of which was composed of a bundle of fine iron wires) was used in place of coil A (fig. 1); and a small coil of fine wire taken from a hand telephone was arranged a little to one side of the pole to represent coil B. The small coil being connected with a telephone, a battery current was passed through the coil of the electro-magnet, and the battery circuit was made and broken by an assistant.

Under these circumstances a much better balance was obtained than could possibly have been anticipated. Upon now bringing a leaden bullet near the small coil, a distinct ticking sound could be heard from the telephone each time the battery circuit was made and broken.

Being absent from my laboratory, and without facilities for proper experiment, I communicated my ideas to Mr. Charles Williams, Jun., of Boston, manufacturer of electrical and telephonic apparatus, who kindly placed the resources of his large establishment at my service; and, at great personal inconvenience, delegated his best workmen to attend to my experiments.

Upon attempting to devise an appropriate form of apparatus for the special purpose in view, I saw that there were great practical difficulties in the way of utilising the arrangement shown in fig. 1, and it occurred to me that the apparatus of Prof. Hughes might perhaps be employed with more advantage as the basis of my experiments. In the ordinary form of Hughes' induction balance, four coils are used, as shown in fig. 2. Through the agency of a Hughes microphone, the ticking of a clock is made to create an electrical disturbance in the voltaic circuit containing the

* A preliminary notice relating to this paper was published in the *Comptes Rendus* of the French Academy of Sciences, Oct. 24th, 1881.

† Pogg. Ann. Vol. liv., pp. 305-335.

‡ A similar apparatus was independently devised in America a number of years ago by Prof. Rowland, of John Hopkins University. It is to be regretted that his discovery of the fact that he had been anticipated by Dove prevented Prof. Rowland from completing and publishing his researches.

§ Phil. Mag., July, 1879, Vol. ii., p. 50.

‖ Phil. Trans. for 1879, p. 417.

* Silliman's Journal, xxviii., 329; xxxviii., 209; xli., 117.

two primary coils, A C, and a corresponding disturbance is produced by induction in the two secondary coils, B D, connected with the telephone. If the connections are so arranged that the currents induced in the telephone circuit by the coils, A C, are in the same direction, the ticking of the clock is heard very plainly, but if they are in opposite directions no sound is perceived.

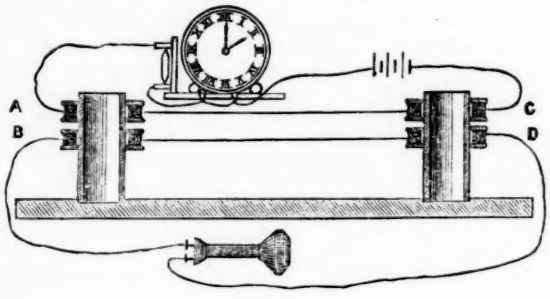

FIG. 2.

In the latter case the action of one primary coil, A, opposes that of the other, C, and an electrical balance results. If now a piece of metal is brought near one pair of coils, say, A B, the balance is disturbed, and the ticking of the clock is audible at the telephone. The arrangement of the coils, A, B, C, D, was the point to be studied, the microphone attachment being of no importance in the combination; for it is well known that a rheotome to break the primary circuit completely at intervals can be substituted for the microphone with advantage.

It seemed to me that two of the coils, A B, in the Hughes induction balance might be attached rigidly to a wooden handle, so as to be moved over the seat of the bullet without changing their relative positions, and that all the adjustments necessary might be made on the other pair of coils, which need not be moved from their place, and would not, therefore, be liable to disarrangement. If a single pair of coils were to be used, as in fig. 1, they must be adjustable one upon the other. But if during the course of exploration the coil B, fig. 1, should be moved from its proper position, even to the extent only of a small fraction of a millimetre, the balance would be disturbed and the exploration might have to be stopped in order to adjust the apparatus. These considerations led me to the conclusion that some modification of the Hughes induction balance was most suitable for my purpose, and I immediately commenced the construction of such an apparatus.

Suggestions Tested.

Just at this time I learned from the newspapers that Prof. Simon Newcomb, of Washington, had the idea of using a magnetic needle to indicate by retardation of its rotation the proximity of the bullet in the body of the President, and I telegraphed to Prof. Newcomb the offer of my assistance in carrying on experiments, knowing the comparative difficulty he would experience in having apparatus made in Washington.

At his suggestion I tested the point whether the rotation of a leaden disc and of a leaden bullet underneath a delicately-suspended magnetic needle would cause a deflection of the needle.

The disc occasioned a deflection, but the bullet produced no sensible effect. I telegraphed the result to Prof. Newcomb, and at the same time took occasion to inform him of the hopeful results I had obtained with the crudely-constructed induction balance referred to above.

I was much gratified by his immediate appreciation of the experiment. He telegraphed that he thought an induction balance promised a much more hopeful solution of the problem than his own method, and encouraged me in every way to continue my experiments.

This appreciation determined me to proceed to my laboratory at Washington, where I was accompanied by Mr. Sumner Tainter, who was anxious to assist in such a cause. I learned from Prof. Newcomb that Mr. Geo. M. Hopkins, of Brooklyn, had independently suggested the use of Hughes' induction balance, and had made experiments in Brooklyn, the results of which were published in the New York *Tribune* on the 11th of July, 1881. Mr. J. Stanley Brown (private secretary of President Garfield) kindly handed to me the letters he had received from Mr. Hopkins, and also a Hughes induction balance like that shown in fig. 2, which Mr. Hopkins had forwarded to the Executive Mansion for trial.

This apparatus was at once tested in my laboratory, with results slightly better than those I had obtained in Boston.

My Boston apparatus did not give a greater hearing distance than 3 cm., whereas with the Hopkins apparatus I could distinguish effects at a distance of 3·75 cm.

Two of Mr. Hopkins' coils (A B, fig. 2) were then fastened upon a wooden handle to form an exploring instrument, and the whole apparatus was arranged for immediate use in case of any necessity arising for an experiment upon the President. I set myself in communication with Mr. Hopkins, and requested his assistance and co-operation, and in reply received through Private Secretary Brown the following account of further experiments:—

60, IRVING PLACE, BROOKLYN, *July 16th*, 1881.

MR. J. STANLEY BROWN.

Dear Sir,—I have made two new instruments on plans differing from that sent, but they yield no better results. The first consisted of two oblong coils arranged at right angles to each other, thus:—

FIG. 3.

The outer coil being of coarse wire (No. 18), placed in the primary circuit, the inner coil being of very fine wire (No. 36), and connected with a telephone. The parallel currents traversing the wires neutralised each other, and no audible effects are perceived in the telephone, but on presenting a metallic body to the instrument upon a line bisecting the angle between the coils the clicking in the telephone is heard.

This instrument possesses only one advantage over that sent, and that is that it requires no adjustment.

The other instrument consists of two large coils of very fine wire (No. 36), placed upon opposite sides of a coil of coarse wire (No. 16), the fine coil being connected so that the induced currents neutralise each other, thus:—

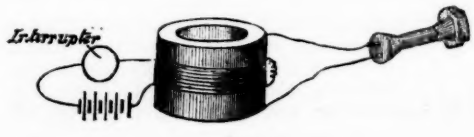

FIG. 4.

I am sorry to be obliged to say of this as of the other, that it is no more sensitive than the one sent. To produce the best effects from the instrument which you have it will be necessary to use all the battery power possible without burning the coils, and two receiving telephones of the best construction must be used.

As I stated in the first instance, if the ball is more than two inches deep, I think it cannot be located by this means.

If larger coils were used the instrument might be operative at a greater distance, but the area indicated as containing the ball would be so large that the result would be indefinite and without value.

Hoping that Prof. Bell will be able to succeed, I remain,

Yours very truly,

GEO. M. HOPKINS.

Prof. Hughes of London, England, Prof. Trowbridge of Harvard College, Prof. Rowland of John Hopkins University, and other authorities were consulted by telegraph as to the best theoretical form of induction balance for the purpose required, while empirical experiments were being carried on under my direction in my laboratory at Washington by Mr. Sumner Tainter; in the electrical work-shop of Davis and Watts in Baltimore, by Mr. J. H. C. Watts, and in the establishment of Mr. Charles Williams, Jun., in Boston, by Mr. Thomas A. Gleason. To test the influence of size of coil an instrument was constructed in which the coils were no larger than the bullet for which he sought (as had been

suggested by Prof. Newcomb), and experiments were also made with the enormous coils used by the late Prof. Henry in his researches upon induction, which were kindly lent to me for the purpose by the Smithsonian Institution, but neither the small nor the large coils produced more satisfactory results than those we had already obtained.

To test battery power, 20 enormous Bunsen elements, which had formerly been used to light the gas at the capitol, were placed at my disposal by Mr. Rogers, the electrician of the capitol, but while great electromotive force was evidently of use we derived no advantage from such a battery as this.

To test the influence of speed of interruption, Mr. Marean, Superintendent of the Western Union Telegraph Co. in Washington, kindly lent us an electric-motor, by means of which we were able, with the aid of a rotating commutator, to obtain interruptions of the primary circuit of all rates up to 600 interruptions per second,* and we found that the more rapid the rate of interruption the more distinct was the sound in the telephone. The hearing distance, however, was not proportionately increased. The automatic interrupter (shown in fig. 5), yielding about 100 interruptions per second,

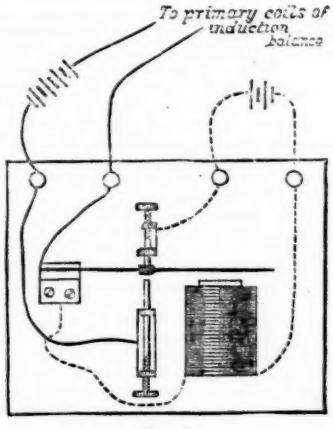

FIG. 5.

gave as good results as any, and was much more convenient. This interrupter was, therefore, afterwards used exclusively in our experiments.

The theoretical form of coil suggested by Prof. John Trowbridge was substantially the same as that proposed by Prof. Rowland, and is shown in fig. 6.

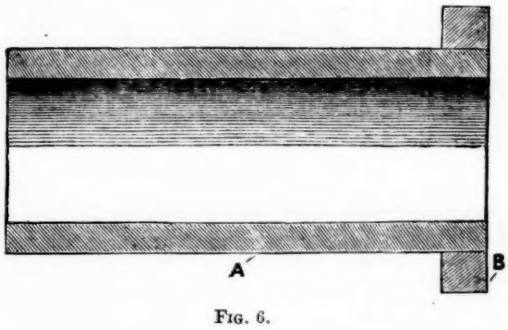

FIG. 6.

The arrangement was quite sensitive to metal placed in the interior of the coil, but the hearing distance for a bullet external to the coils was no greater than before.†

Prof. Hughes proposed to have two flat superposed coils wound on a single reel, so that the two coils should form a single one as regards their relative distance; and Mr. F. T. Bickford, Washington correspondent of the *New York Tribune*, suggested winding two wires side by side into a single coil, so that the relative distances of the wires from the bullet should be absolutely the same. M. Chas. E. Buell and Dr. Chichester A. Bell proposed to determine the depth of the bullet beneath the surface by causing a similar bullet to approach the balancing coils until silence was restored; the secondary bullet, it was presumed, would then be at the same distance from the balancing coils as the embedded bullet from the exploring coils.

The results of all the experiments so far made were unsatisfactory. I had tried everything that had been suggested, but 4 cm. remained the extreme limit of audibility for a bullet like that which had struck the President. Even when such a bullet was flattened by being fired against a board, and was presented with its flat side towards the coils of the explorer—the most favourable mode of presentation—no better result was obtained.

(To be Continued.)

* Mr. Sumner Tainter has since made an apparatus operating in a similar manner by means of which he has obtained as many as 4,000 interruptions of the circuit per second.

† The balance obtained was not quite perfect, and we have since discovered that the insulation of the wires of one of th secondary coils was defective.

THE INSTITUTE OF PATENT AGENTS.

(INCORPORATED 1882.)

Address of J. H. JOHNSON, Esq., President.

[Delivered at the Inaugural Meeting, November 29th, 1882.]

GENTLEMEN,—You will probably think it due from me—elected, as I have been, to the honourable post of first President of our Institute—that I should say a few words at what, I hope, will be the commencement of a long series of annual meetings.

In the first place, I must express my sincere thanks for the great honour which has been done me, and I trust that the Institute will have no ground, during my tenure of office, to regret the choice which it has made.

The Institute of Patent Agents has been in the minds of some of us for many years. Probably there is no profession which has more need of such an institution. You are aware that the objects for which the Association is established are:

Firstly:—To form a representative body of the Patent Agents of the United Kingdom for the purpose of promoting improvements in the Patent Laws and in the regulations under which they are administered;

Secondly:—To frame and establish rules for the observance of Patent Agents in all matters appertaining to their professional practice; and,

Thirdly:—To extend their opportunities and facilities for meeting, correspondence, discussion, and interchanging ideas respecting matters connected with their professional practice, and generally to aid in the acquisition and dissemination of knowledge appertaining to their profession.

The Institute is to be composed of Fellows, Associates, Foreign Members, and Honorary Members, with a class of Graduates.

The first Fellows of the Institute are the gentlemen who joined it on its formation; including, I think I may fairly say, all the prominent Patent Agents of the day, both in London and in the country.

For the future, a Fellow must be more than twenty-five years of age, and must come within one of the following conditions:—

(*a*) He shall have practised on his own account in the United Kingdom for at least five years, and have acquired good repute in the profession of a Patent Agent; or,

(*b*) He shall have been, for at least seven years, engaged as a pupil or assistant in the business of a Fellow of the Institute, and have acquired such knowledge as to qualify him to practise as a Patent Agent; or

(*c*) He shall have passed an examination in Patent Law and practice in mechanical drawing and in such technical or other subjects as the Council may deem requisite; such examination being conducted by the Council, or by examiners appointed by them.

Associates are to be persons of more than twenty-five years of age who are not Patent Agents by profession, but who, by their connection with the law, science, or the arts, are, in the opinion of the Council of the Institute, qualified to advance the objects of the Institute, or shall be persons who have been graduates of the Institute of three years' standing.

Foreign members shall be Patent Agents established in practice in foreign countries or the British Colonies, and neither having an office nor practising in the United Kingdom.

Honorary members are to be distinguished individuals who, from their position, are enabled to render assistance to the profession.

Graduates are to be persons not under eighteen years of ago, who are or have been pupils or assistants of Fellows of the Institute, and have the intention of becoming Patent Agents.

Fellows are to be proposed, in writing, by a Fellow of the Institute, and recommended by four other fellows.

Fellows may also be admitted to the Institute by examination, in which case they must be proposed by one fellow and seconded by another.

A member may be passed from the class of associates to the class of fellows at a general meeting of the Institute.

Foreign members and honorary members must be proposed by the council, and their names submitted for election by ballot, as in the case of fellows and associates.

I need not trouble you with the further steps to be taken with respect to the election of various classes of members; they can always

be ascertained on application to the Secretary of the Institute; but with regard to the fees payable, I may state that:—

Fellows are to pay an entrance fee of six guineas, and an annual subscription of four guineas.

Associates, an entrance fee of three guineas, and an annual subscription of two guineas.

Foreign members, an entrance fee of two guineas, and an annual subscription of one guinea.

Graduates, an entrance fee of one guinea, and an annual subscription of one guinea.

The affairs of the institute are to be managed by a council chosen from among the fellows only, and consisting of one president and one vice-president, of eight ordinary members of council, and of the past presidents.

It will be seen that the present list of the council comprises the names of members of most of the principal London firms, and of one patent agent residing in Glasgow, and one residing in Birmingham.

It is quite probable that some Patent Agents entitled to admission to the institute have not been invited to assist in its formation. We wish it to be understood, as to any such gentlemen, that their non-inclusion in the first list of members is no slight on them, and that the council do not profess to have invited the co-operation of all qualified practitioners, but only of those with whom some member of the council was acquainted. They considered it necessary, in the first instance, to adopt this method of procedure, as no other means of selection appeared to be open to them. The council could not undertake the personal responsibility of approving every name they heard of as that of a Patent Agent without knowing anything whatever of the position or qualifications of the person referred to. It was, therefore, deemed best to invite the assistance of a sufficient number to form a nucleus for electing applicants in accordance with the formalities prescribed by the regulations. The course they have followed has been prompted solely by regard for the interests of the Institute, and has not been in any sense attributable to a desire to exclude any Patent Agent who can be regarded as properly qualified for admission. On the contrary, they will be happy to receive applications for admission from gentlemen practising the profession who are not yet members.

The moneys of the Institute are to be entirely devoted to the prosecution of the objects for which it was formed; but I am afraid that its funds—at all events during its early stages—will scarcely do more than pay the current expenses which it is absolutely necessary for the institute to incur.

Our idea in forming the Institute of Patent Agents has been that it will be useful in making us better acquainted with each other on the ground of common interest, and in facilitating discussion on all questions of interest to patentees and to ourselves. There are frequently questions arising of great moment to our clients upon which an individual agent can exert but little influence; and it is hoped that this institute will be able to deal with such questions with an authority no individual member could hope to possess.

Much good has been done by professional institutes founded, like ours, for the purpose of drawing together the members of the profession, and for extending their opportunities and facilities for meeting, correspondence, discussion, and for the interchanging of ideas connected with matters relating to their professional practice.

I need only refer you to the Law Institution (which has done much to elevate the status of solicitors), the Institution of Civil Engineers, the Royal Institute of British Architects, the Institute of Surveyors, and the Institute of Chartered Accountants. All these bodies number a great many more members than we do at present, or are likely to do; but the profession of a Patent Agent, properly carried on, relates to as important a class of interests, and requires the possession of as great a degree of trained skill and aptitude, as do the professions represented by the institutes to which I have referred. The Institute will, we trust, give us a greatly improved status; and we look forward to the time when our Institute will have as important an influence on our profession as the institutes referred to have in the professions to which they relate.

The profession of a Patent Agent has not been carried on as a separate branch of business, in this country, for more than sixty years.

My own personal knowledge of it extends to a period of something like thirty-three years.

Prior to the passing of the Patent Law Amendment Act, 1852, Patent Agents' business was of a comparatively limited character. The number of patents annually taken out in England, at that time, not amounting to more than 550; but the Patent Law Amendment Act was the precursor of an entirely new era in the profession. The number of patents was greatly increased, and there was also a very great increase in the number of patents applied for by British subjects in foreign countries.

I need scarcely remind you that, prior to the Patent Law Amendment Act, the British patent covered our Colonial possessions; but, as it was decided that the British patent should not, from that time, extend to the British Colonies, nearly every Colony of importance has now passed a Patent Law of its own, and the number of Colonial patents has vastly increased. This has greatly extended the sphere of operations of Patent Agents and has necessitated the establishment of agencies in all the important Colonies.

Much has been said of late years with regard to the number of patents taken out in this country as compared with the number taken out in the United States. The fees in the United States are no doubt very much lower in amount than they are in this country; but it must be remembered that it is absolutely necessary, in the United States, for an inventor to take out separate patents for a number of heads of the invention, which may all be covered by one patent in this country; and that, when there are conflicting applicants for the same invention, the cost of the American patent is enormously increased.

I believe that, on the whole, the Patent Law Amendment Act has worked very successfully for British inventors. Of course, we all of us know that there are many points in it which might very well be amended, and I cannot help thinking that one great blot in our Patent system consists in the fact that numerous patents are granted, upon mere application, for inventions which any man of intelligence must know to be perfectly old. It therefore appears to me that any Act to amend the Law of Patents should certainly contain some provision with respect to the examination of the applications, and that the applicant should, at least, have pointed out to him by the Patent Office the specifications of similar inventions which are already existing in that office.

It is not possible, in the limited time at my command, to go into any details as to the mode in which such an examination should be conducted, or the principle upon which applications should be rejected. It is sufficient at present to draw your attention to the question—which is certain to be brought forward whenever Parliament can afford time to take up Patent Law reform.

It may be well, therefore, that we should give the matter our serious consideration beforehand, so as to be prepared to deal with it at the proper time.

Various Bills which have been brought before Parliament for the last ten or twelve years have all received the close attention of a Committee of Patent Agents sitting in London, and their recommendations have, from time to time, been brought before the gentlemen in charge of the several Bills, the Law Officers of the Crown, and the Lord Chancellor. It may not be irrelevant here to state that our suggestions have always met with courtesy, and we have found many of these suggestions adopted in Bills of a later date. The Bill which appeared most likely to meet the views of inventors, and to be of most advantage to this country, was the one brought in by Sir John Holker in the year 1879; and the Patent Agents to whom I have before referred were in great hopes that the Bill, with some modifications, might pass, as it would have been a great advance on the present state of legislation on the subject. The Bill was, however, blocked in the House of Commons, and it is to be feared that inventors will find some difficulty in getting the Government again to look upon their interests with the same liberal view they did at that time. You are aware that the Government proposed to bring in a Bill for the Amendment of the Patent Laws last year, but the state of business in Parliament clearly prevented their dealing with the subject. It is now understood that the Board of Trade have a Bill under their consideration, and that it is to be introduced as soon as there is any chance of its obtaining proper discussion. When that Bill is introduced it will be one of the chief duties of the Institute to keep the closest watch upon it, and upon all Bills that may come before parliament on the subject; to do our best to point out where they are faulty, and how they may be improved. The Bills we have hitherto seen all contain provisions more or less crude, more or less impracticable, and more or less dangerous to the interests of inventors. For instance, I cannot help thinking that every plan for making licences compulsory is unworkable, that the patentees and the public should be left free to settle their business in their own way, and that any attempt to interfere with them will be entirely abortive and will do more harm than good.

As to these and other questions relating to the same important subject, it must be manifest to all that the suggestions of our Institute, founded on the mature deliberations of the body of Patent Agents, will have much more weight than those of individuals.

Here and there we meet with persons who preach the doctrine of "No Patents"; but I firmly believe that so long as Government deems it just and expedient to give copyright to authors it will extend patent right to inventors.

I shall not waste your time by arguing on this point, feeling convinced that every one who hears me knows that it would be the height of injustice to deprive the inventor of the fruits of his labour.

It is intended to hold at regular intervals meetings of the Institute, at which papers will be read by members on subjects of interest to the profession. It is hoped that these meetings will also afford the opportunity for discussing questions relating not only to procedure and practice in this country, but in foreign countries and in the Colonies, where the interests of patentees are now becoming of great importance.

The Institute will also afford opportunities for prompt intercommunication of legal decisions in patent cases. It may probably be possible to arrange for the communication, to the Institute, of all legal decisions of importance, considerably in advance of the publication of such cases in the ordinary law reports, whilst decisions in matters of practice before the law officers (as to which there is often much obscurity) may also, with great benefit to the profession generally, be brought to the knowledge of the Institute by the members engaged.

Patent Agents are accustomed to be consulted by inventors, not only on the policy of securing their inventions by letters patent, but upon their commercial dealing with the inventions after they are protected; and our clients are entitled to expect from us the most honourable and straightforward advice. One part of our duty is to restrain them from rushing into litigation when their patents afford no fair grounds for such a course. We all know that the inventor has an extreme idea of the value of his own invention; and we can all repeat instances of clients who cannot understand that the consideration of their particular invention is not the most important subject of the moment.

Patent Agents are also very frequently in a position of much delicacy as regards the claims of rival inventors, through the feeling of jealousy which one inventor has of another. I believe that where the Patent Agents employed are men of honour and position, there is little ground for any jealousy of this kind. I have frequently found that the knowledge I possessed of rival inventions and rival inventors, which was confined to my own office, has been of great benefit by enabling me to warn subsequent inventors of dangers they might otherwise have rushed into.

There has also been considerable difficulty at all times in the selection of proper scales of charges for procuring patents and for other services in relation to patents; but I think the members of an institute of this kind may, by communication with each other, agree on what should be fair to themselves and to their clients. This subject is a kindred one to that of the charges of solicitors, as to which there has also been much recent discussion, finally concluded by an Act of Parliament in the preparation of which the Law Institution had no small part.

It is our great wish to do everything that can be done to maintain the honourable position of Patent Agents, and to give them a place in the estimation of the public, which has scarcely yet been fully attained. If this Institute can attain the position of a central authority, we shall do much to effect the objects I have mentioned; it being our desire, on the one hand, to provide a check against all irregularities in professional practice, and, on the other hand, to secure to the members of the Institute that fair consideration from their clients to which they are entitled.

The council have power, by the articles of association, to exclude from membership of the Institute all persons convicted of any irregularity in the practice of patent agency. The members may rely upon it that no part of the duties of the council will be more onerous or more unwillingly undertaken; and it is hoped that there will be few, if any, cases in which this authority has to be exercised.

You will observe that we have taken power to admit, as members of the Institute, Patent Agents practising in the different foreign States. We shall be in constant communication with these agents; and I cannot help thinking that much may be done to facilitate the labours of English agents by a well-arranged system of such correspondence.

We look forward to the time when we may collect a library that shall be valuable to our members and to all interested in patents in this country; but we may be some time in attaining this object, owing to the expense that must necessarily be incurred in the formation and preservation of such a library.

The council will be, at all times, willing and desirous to receive communications from agents upon all subjects connected with the objects of the Institute and the well-being of the profession; and as we shall meet at frequent intervals, all such communications will have our most careful consideration.

The selection of a competent person to fill the office of secretary has been a matter of considerable difficulty and anxiety to the council. The development of the Institute must necessarily depend to some extent on the ability and energy of this officer. It will be essential that the existence and importance of the Institute, and the qualifications necessary for admission thereto, be made widely known; otherwise influence cannot be acquired for itself as a body or for its members individually. The labour involved in securing these results will principally devolve on the Secretary, in addition to the routine business of the Institute. The council believes that the gentleman selected (who has had considerable experience in the formation of other institutions) possesses the qualifications necessary for the effective fulfilment of the duties of the office.

Having put before you, Gentlemen, the objects and interests of this Institution, it is only for me to say that our success can only be assured by the hearty co-operation of all its members; and this, I hope, we are already assured of, as the formation of an institute of this kind seems in itself a proof that the members are desirous of effecting the objects I have pointed out.

THE EXPERIMENTS OF MIESBACH-MUNICH.

EPILOGUE.

THE fact which has just transpired at the Société Française de Physique shows that we must give up all hope of the last word about the experiments on the transmission of power to a distance between Miesbach and Munich, the results of which have been so much exaggerated, with an object which is easily understood.

We give further on an extract from the *Comptes Rendus*, of the sitting of December 1st, 1882, which will throw a curious light upon this mysterious affair, and which will show how much reason we have to suspect the return of 68 per cent.

We have not here to defend or to criticise the mode of calculation adopted by M. Cabanellas, but only to establish the authenticity of the figures which have served for the foundation of the discussion.

Now, M. Cabanellas borrowed these figures from the *Bulletin de la Société Générale des Téléphones*, who held them from M. Sarcia. M. Cabanellas communicated his work to Dr. Von Beetz, the manager of the Munich Electrical Exhibition, and on October 28th, Dr. Von Beetz replied to M. Cabanellas in a letter which, at our request, the recipient was kind enough to send to us, and from which we extract the following passage:

SIR,—I hasten to thank you for your extreme kindness in sending me your publications and the reports in manuscript. Being still occupied with the electro-technical measurements which form the basis of our exhibition, I have only, up to the present, found time to read the letter. It is with the greatest interest that I have followed your calculations, which seem to me as convincing as simple. As to the results obtained by M. Deprez, it is impossible to come to definite conclusions from them. The provisional figures which you have employed are those which M. Deprez found (see the continuation in the *Compte Rendu*, of the sitting of the *Société Française de Physique*, at the end of this article).

Notwithstanding this unequivocal assertion of Dr. Von Beetz, M. Marcel Deprez continues to deny *a part* of the figures given in the *Bulletin de la Société Générale des Téléphones* and confirmed by the manager of the Exposition de Munich. The explanation of all these contradictions and denials is not perhaps so difficult to find as one would think at first. In the first moments of material success figures were quoted somewhat at random, without even taking the trouble to consider the conclusions which might be drawn from them, and without inquiring whether they showed a sufficient concordance among themselves. But as "*tout mauvais cas est niable*," according to a French proverb, it is found simpler to deny them when they are compromising.

We shall return no more to the experiments of Miesbach-Munich, for Dr. Von Beetz has summed up their extent in these conclusions which shall be also ours:—

It is impossible to draw definite conclusions from the experiments of M. Marcel Deprez.

The only experiments which the committee were able to make before the destruction of the machines furnished mechanical returns of 23 and 32 per cent.

It will be necessary to wait before deciding for or against until M. Marcel Deprez shall have repeated his experiments upon a larger scale.

E. H.

SOCIÉTÉ FRANÇAISE DE PHYSIQUE.

(Extract from the *résumé* of the communications made at the sitting of December 1st, 1882, under the Presidency of M. Gernez.)

After the reading of the official report of the sitting of November 17th, the President communicated two letters which had been addressed to him, one by M. Sarcia the other by M. Deprez.

M. Sarcia wrote that, "1st, The figures upon which M. Cabanellas supported his calculations are erroneous, as he says; 2nd, The authenticity of the figures which he has disputed is by no means established by the letter of M. Beetz where they are not to be found; 3rd, He did not say that the Carpentier brake included the frictions and passive resistances, but quite the reverse."

M. Deprez complains of the partiality with which the minutes have been drawn up; of the omission in the report of the numbers employed by M. Cabanellas; lastly, of the non-insertion of the letter of Dr. Von Beetz. He adds that in consequence of these facts he has resolved to cease from this moment to belong to the Société de Physique.

M. Guerout disputed that the conclusions can be drawn from the letter of Dr. Von Beetz which M. Cabanellas deduces from it.

Upon this occasion the President thought proper to remark that the *rôle* of the Bureau in the publication, necessarily much abridged, of the report, is simply to reproduce with all possible accuracy the ideas expressed by the persons who had the honour of speaking before the society, leaving to each the entire responsibility of his opinions and not feeling called upon to decide between contradictory opinions or assertions.

Mention will be made in the report of the claims of Messrs. Sarcia, Deprez, and Guerout.*

Resistance of each of the machines	470 ohms
Resistance of the telegraphic circuit ...	950 ,,
Speed of the generator (Miesbach)	2,100 revolutions
Speed of the receiver (Munich)	1,400 ,,
Difference of potential at the terminals of the generator	2,400 volts
Difference of potential at the terminals of the receiver	1,600 ,,
Current intensity	0·5 ampères
Work	37·5 kilos.

The point was declared settled and the report adopted.

* In compliance with the request of M. Deprez, the Bureau thought proper to give in a note the numbers which served as the foundation of the discussion and an extract from the letter of Dr. Von Beetz.

(Extract from a letter from Dr. Von Beetz to M. Cabanellas.)

"MUNICH, October 28th, 1882.

" . . . The provisional figures which you have employed are those which M. Deprez had found. The Committee commenced by measuring the constants of the machines and of the circuit, at first at 1,600 revolutions of the generator. A mechanical return of 23 per cent. was obtained, and at 2,000 revolutions 32 per cent. But suddenly one of the brushes fell, and the induced current produced by this interruption destroyed the fine wires in both machines.

"Now we have not yet obtained the exact figures; we must wait until M. Deprez has repeated his experiments on a larger scale. Until then I shall pronounce no personal opinion either for or against."

PROCEEDINGS OF SOCIETIES.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, December 14th, Lt.-Col. WEBBER, R.E., President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members announced, the annual report of the Council of the Society was read by the secretary.

During the past year the numbers of the Society had been increased by the election of 9 foreign members, 10 members, 74 associates, and 7 students, or a total of 100. In addition to the foregoing, 5 new candidates would be balloted for on the present evening, and 39 on the next meeting. The Society had, on the other hand, lost by deaths 5 honorary members, 10 members, and 17 associates, amongst whom were Capt. Gill, Mr. Hockin, Mr. Laws, and Mr. Schwendler. The Institution of Civil Engineers had, with great kindness, continued to grant the use of the lecture hall for the purposes of the Society. The Secretary then read a list of the papers which had been brought before the Society during the year. In the *Proceedings* of the Society would be found a large number of original communications of great interest. The General Index to the first ten volumes of the *Proceedings* had been completed. The entertainment given at Chatham at the School of Engineering of the Royal Engineers was next alluded to. It was also pointed out that during the year an International Congress had been held at Paris, and also Electrical Exhibitions at Munich and at the Crystal Palace, and that a further exhibition was to be held at the Royal Aquarium at Westminster. During the last year a very large amount of capital had been subscribed for electric lighting enterprise, and, as a consequence, a very considerable amount of fresh information had been obtained on the subject. At the International Congress at Paris the subject of the protection of submarine cables had been fully discussed, and certain recommendations were drawn up, which had been submitted to the various Governments. The questions of the redetermination of the electrical units, lightning protectors, and the observation of earth currents, had also been considered.

The insurance companies having had to consider the liabilities to fire which arose from the use of the electric light, the Society had drawn up a code of rules, which was adopted by all the offices.

The surplus moneys from the guarantee fund for the late Paris Electrical Exhibition, amounting to £110, had been invested, and this, together with a grant from Mr. Fahie, enabled the Society to offer three annual premiums for papers read before the Society, of the relative values of £10, £5, and £5. It it hoped that these premiums will stimulate the younger members of the Society.

The gratuitous services rendered by the foreign secretaries were then mentioned.

The honorary solicitors to the Society had made application for the incorporation of the latter under the Limited Liability Act.

The finances of the Society were highly satisfactory. The life compositions, amounting to £741, will be invested in securities almost immediately.

The "Report of the Librarian" was next read. The number of visitors to the library was more numerous than during the previous year, but the evening attendance was small. The number of members who had signed the attendance book was 313; the number of non-members, 248; the total number of visitors, allowing for those who had not signed, was probably about 600. The Specifications of Patents were very much referred to and have been proved very useful. The thanks of the Society were due to Mr. R. Morris, of the Patent Office, for the prompt despatch each week of the newly published Specifications. The library had been increased by the addition of 245 new works, which was 80 more than last year. Most of the additions are gifts, but several works were obtained by purchase. In future it is intended that the names of the new volumes added to the library shall be announced at each ordinary general meeting. It is proposed to add books on physical science generally in addition to those on electricity purely. The Librarian, in his report, alluded to a suggestion which had been made by Mr. Kempe at a previous meeting, viz.: that the Electrical Patent Specifications should be indexed. This proposal, he considered, would be very useful if carried out. A classified index of the library would also be very valuable, as a catalogue of names alone often failed to enable a person to find a work on a particular subject. A great many applications were received for books treating on particular subjects, and it was difficult to pick these out. These suggestions would probably be worth the consideration of the council.

The usual votes of thanks to the Institution of Civil Engineers, the Foreign Secretaries, &c., having been proposed, seconded, and carried unanimously, a paper by Mr. T. J. LARKIN, Member, on "The application and Extension of Telephonic Communication in Japan," was read by the Secretary.

The use of telephonic communication for police purposes had never been considered in England, but in Japan it was carried into effect with great success. In one of the principal cities, containing 300,000 inhabitants, the police force had at first great difficulty in keeping order, consequently, in 1878, a telegraphic system with nine offices was introduced, worked by Morse printers. The wire used was of No. 11 gauge. On the invention of the telephone the latter instrument was substituted for the printers, and with great success, as the intermittence in the work with the ordinary instruments was much disliked by the operators, who were continually resigning their situations, causing great inconvenience. The Bell telephones were the instruments employed, and were worked by the police staff without difficulty. The first were purchased, but afterwards they were manufactured locally with perfect success. Four telephones on one circuit were employed in some cases, the stations being called up by so many strokes on a bell. One of the lines was eight miles long, and ran on poles with other working wires; although the inductive disturbance was very strong it did not prevent proper working. Experiments were subsequently tried on 57 miles of railway, with 17 stations, with every success, and it was finally decided to adopt the telephones for block as well as ordinary signalling. Several instances were given of the value of telephonic communication as compared with the ordinary telegraph system. By means of shackles placed on the poles at every mile, it would be possible, in case of a railway accident, for the guard to connect up a hand telephone and communicate with the nearest station.

A vote of thanks to Mr. Larkin having been proposed, seconded, and carried, the result of the balloting for the new Council for 1883 was announced as follows:

President—Willoughby Smith. Past Presidents—Charles William Siemens, D.C.L., LL.D., F.R.S.; Frank Ives Scudamore, C.B.; Sir William Thomson, LL.D., F.R.S; Latimer Clark, M. Inst. C.E.; C. V. Walker, F.R.S.; Professor Abel, C.B., F.R.S.; Lieut.-Colonel J. U. Bateman-Champain, R.E.; W. H. Preece, F.R.S., M. Inst. C.E.; Professor G. C. Foster, F.R.S.; Lieut.-Colonel C. E. Webber, R.E., C.B. Vice-Presidents—Professor W. G. Adams, F.R.S.; C. E. Spagnoletti, M. Inst. C.E.; Professor D. E. Hughes, F.R.S.; Sir Charles Bright, M. Inst. C.E. Hon. Treasurer—Edward Graves. Hon. Secretary—Lieut.-Colonel Frank Bolton. Council—Members: W. S. Andrews; William T. Ansell; E. B. Bright; H. G. Erichsen; H. C. Forde, M. Inst. C.E.; J. Fletcher Moulton, F.R.S.; Alexander Siemens; Augustus Stroh; C. F. Varley, F.R.S.; Professor W. E. Ayrton, F.R.S.; T. Russell Crampton, M. Inst. C.E.; Dr. J. H. Hopkinson, M.A., F.R.S. Associate Members of Council—Lieut. Arthur H. Bagnold, R.E.; Shelford Bidwell, M.A., LL.B.; J. C. Lamb.

The meeting then adjourned till January 13th, 1883.

PHYSICAL SOCIETY.—December 9th.

Prof. Clifton, President, in the chair.

New Members—Mr. H. E. Harrison, B.Sc. ; Mr. S. T. H. Saunders, M.A.

Prof. G. Forbes read a paper on "The Velocity of Light of Different Colours." The author concluded, from his experiments described to the society a year ago, that blue rays travel quicker than red rays. M. Cornu had endeavoured to explain this result by peculiarities of the apparatus employed, but this explanation seemed doubtful. It was suggested that the experiments might be repeated with such modifications of the apparatus as would set the question at rest.

Profs. Ayrton and Perry read a paper on "The Resistance of the Voltaic Arc ; or, the Opposition Electromotive Forces set up." The E.M.F. was measured by a voltmeter connected between the terminals of the lamp. Keeping the width of arc constant, the E.M.F. was found to diminish as the current increased. Keeping the current constant, the E.M.F. increased rapidly at first with an increasing width of arc, and afterwards more slowly. The authors gave a curve representing the change. About 80 volts are required to produce an arc of $\frac{1}{3}$ in. For further increase of arc E.M.F. is therefore proportional to increase of length of arc.

The authors also read a paper on "The Relative Intensities of the Magnetic Field produced by Electro-magnets when the Current, Iron Core, and Length of Wire, &c., are constant, but the wire differently distributed." In *a* case the wire was wound uniformly from end to end ; in *b* case it was wound from the middle to one end ; in *c* case it was wound only at both ends ; in *d* case it was wound only at one end. The field was measured along a line running through the axis of the poles beyond the magnet. Of the above plans *a* gave the strongest field, except at short distances, when *b* was best.

Profs. Ayrton and Perry also exhibited a set of three Faure accumulators in series feeding 20 Swan lamps, each lamp giving over 1 candle-power. The E.M.F. of each cell was about 2 volts.

Next meeting January 27th, 1883.

Phillips *v.* The Great Western Electric Light and Power Company (Limited).

This was an application in the High Court of Justice, Chancery Division, before Mr. Justice Chitty, by a shareholder of ten shares in the company for the rectification of the register of the company by striking out his name from the list of shareholders. It was stated in the prospectus that the company had secured a concession from the Anglo-American Brush Electric Light Corporation (Limited), under which the exclusive right of use or sale of their dynamo machines and arc lamps, together with an exclusive licence to use or sell the Lane-Fox incandescent lamp, was secured to the company for a considerable part of the West of England and South Wales. It was stated on behalf of the applicant that on the 20th of July, 1881, Mr. George Lane-Fox assigned to the British Electric Light Company the exclusive right of using and granting licences to use his inventions in Great Britain and Ireland, and that on the 29th of July, 1881, Mr. George Lane-Fox executed a similar assignment to the Anglo-American Brush Electric Light Corporation, subject, nevertheless, to the previous assignment of the 20th of July, 1881. It was contended that the statement in the prospectus with respect to the exclusive right of the company to use or sell the Lane-Fox incandescent lamp in the district named was incorrect. The applicant, without alleging any *mala fides* on the part of the company's promoters and directors, submitted that he was induced by what was in fact a false representation to subscribe for the shares in question.

The application was opposed on the ground that if a misstatement had been made, it was not material, since the Lane-Fox lamp was the least valuable of the inventions conceded to the company by the Anglo-American Corporation.

Mr. Justice Chitty said that it was plain to an ordinary mind that there had been a misstatement which was material and calculated to mislead the applicant. His Lordship also thought that it was not competent for persons who had issued a prospectus which had recommended as one of its leading attractions this particular invention to afterwards say that the invention was of little or no value. The application must therefore be granted with costs, and the sums paid in respect of the shares returned to the applicant by the company.

[We regret that the pressure on our space last week rendered it necessary to leave this matter over, more especially as a subscriber has since written to us asking for information.—Eds. Elec Rev.]

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," Electrical Review, 22, Paternoster Row, London, E.C.

Letters respecting Advertisements, Subscriptions, &c., should be sent to the "Publisher," Electrical Review, at above address.

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CORRESPONDENCE.

ELECTRICAL ACCUMULATORS.

To the Editors of The Electrical Review.

Gentlemen,—I was present to-night at a lecture, given under the auspices of the Limehouse Scientific Society, at the Town Hall, and, while profiting by the clear and concise manner in which the whole subject was treated, aided by a profusion of experiments with extensive apparatus familiar in principle to all of us, I was chiefly interested in the great success of the lecturer, Mr. Reckenzaun, in producing an efficient light of considerable power and duration from an arc lamp by means of a current furnished through accumulators of small proportions.

This, I think, must be the first time it has been successfully accomplished ; at any rate, I have never yet seen it done at any lecture in a manner that could be so described ; and I should esteem it a favour if Mr. Reckenzaun would see fit to oblige your readers with some explanation of his method.

I understood him to say that the accumulator was constructed on the lines of Messrs. Sellon and Volckmar, and it very efficiently provided current for a Pilsen arc lamp, a string of Swan and other incandescence lamps, driving also three different motors, of which the swiftest and most compact seemed to me to be one stated to be going at about 3,000 revolutions per minute, and, unless I misunderstood him, of the lecturer's own invention.

Yours truly,

London, 13*th December*, 1882. B. UNWIN.

[Some time since a "Pilsen" arc lamp was exhibited at Charing Cross, the current being supplied by Faure accumulators.—Eds. Elec. Rev.]

AN IMPROVED THOMSON REFLECTING GALVANOMETER.

To the Editors of The Electrical Review.

Sirs,—What I wished to point out with reference to the relative effects of different parts of the coil, and what I still maintain, is that the nearer the wire is to the needle the greater will be its effect for the same current. Surely it is

well known that in a tangent galvanometer, where the size of the coil is not only *not small*, but *very large*, "compared with the size of the space within which the needle swings," "the total result of all the turns" is *trebled* by adding one other turn of half the diameter of the first and putting it in series with it; and in my instrument, so far from getting only a "few extra turns set close to the needle," I would draw attention to the fact that *more turns* can be got in the *central* $\frac{3}{4}$ of an inch than can be got in the *next* $\frac{3}{4}$ of an inch diameter, as with very great propriety a smaller wire can be used.

With regard to the damping effect of the metal frame there is no reason, when a ballistic galvanometer is required, why this may not be omitted; but no one would dream of using such an instrument for ordinary work, or of using any ordinary reflecting galvanometer for taking discharge deflections, if anything approaching accuracy were required.

Yours truly,

December 13*th*, 1882. F. J. MUDFORD.

[With reference to the last paragraph in Mr. Mudford's letter we would point out that the writer is quite in error in supposing that "no ordinary reflecting galvanometer would be used for taking discharge deflections if anything approaching to accuracy were required." As a matter of fact the ordinary reflecting galvanometer is always so used in every cable factory and in every laboratory which possesses such an instrument, and perfect accuracy can be and is obtained by the methods well known and always used by every electrician who knows anything of his work. We are not aware that "it is well known that ..... the total result of *all* the turns is trebled by adding *one* other turn of half the diameter of the first, and putting it in series with it." It is well known that "the effect of *one* particular turn is trebled by adding *one* other turn of half the diameter of the first and putting it in series with it," which is a very different thing. As we stated, we quite appreciate the value of the new galvanometer, but as regards the two points in question we think they do not possess the advantages claimed.—Eds. Elec. Rev.]

PERSONAL.

To the Editors of The Electrical Review.

Dear Sirs,—I find that an impression prevails that I am connected with the J. B. Rogers Company on the Viaduct. Will you kindly permit me to say that I am in no way, directly or indirectly, connected with this or any other company, and that my only place of business is still, as it has been for some years past, at 21, Finsbury Pavement?

Yours faithfully,

FRANCIS M. ROGERS.

21, Finsbury Pavement, *December* 16*th*, 1882.

CONTINUOUS ELECTRIC LIGHTING.

To the Editors of The Electrical Review.

Dear Sirs,—Seeing the article in this day's Review concerning the Edison lights having been kept running continuously for 64 hours, and also that this has never before been accomplished in England, I beg to inform you that I have a 40 arc light "Brush" machine, and a 60 incandescent light Siemens alternating current machine, running here regularly from 6 a.m. on Monday morning to 10 p.m. on Saturday night. It has been found necessary to stop occasionally (about every twelve hours) for a few minutes for oiling and for cleaning the machine, but notwithstanding, I think you can hardly help agreeing with me that this is about the most severe test that any electric light machinery has yet been put to, considering that the Edison Company used two machines, and here there is only one.

I am, dear Sirs, yours truly,

N. MACADAM.

Severn Tunnel Contract, Portskewett, Mon.,
December 16th, 1882.

ELECTRO-MOTORS.

To the Editors of The Electrical Review.

Dear Sirs,—If you should think the following of sufficient interest to your readers kindly give it a place in the pages of your journal, of which I am an old subscriber.

I went last Monday to hear the Cantor lecture of Prof. Silvanus Thompson on electro-motors at the Society of Arts, in the hope of learning something as to any rules and standards by which to judge the merits of a motor. I must confess that I was disappointed; but with the recent rather protracted controversy fresh in my memory which took place amongst noted electricians as to the value of the results arrived at in the now celebrated experiment at Munich, where the opinions differed so widely, and considering that in cases where the dynamo and motor are not identical, the subject must necessarily be still more involved, I was, perhaps, unreasonable in expecting something definite.

There was much that was interesting and valuable in the lecture, and would have appeared to me more valuable still had I been able to bring myself to have more faith in the very principles as laid down by the lecturer upon which he based his deductions as to efficiency of motors. He gave us an outline of the difficulties early inventors experienced. Seeing that when the motor worked the current diminished, they attributed it to an increase of resistance. He said we knew better now, and that the diminution of current was due to a counter E.M.F. set up in the motor and opposing the current. We were told that, calling the E.M.F. of the whole circuit E and the counter E.M.F. e, $E - e$ was energy lost as far as production of mechanical energy was concerned, and the e was, in fact, the measure of the motor's efficiency. As the current diminishes in proportion as e increases, e being a function of speed, the motor would be at its greatest efficiency when the current had ceased altogether.

Now, the efficiency of a dynamo machine is determined by the proportion of electrical energy it produces as compared with the power employed in driving it. A motor, a machine intended to re-convert electrical into mechanical energy, is, we are told, at its highest efficiency when it drives nothing—that is to say, when it does not perform its proper functions. This is an anachronism, to say the least of it. Is the term "efficiency" to have a different meaning in motors to what it has in dynamos? It seems to me very unlikely that rules and standards for comparing relative merits of motors can be constructed upon foundations such as this.

Again, as to the term "counter E.M.F." Either it is unfortunately chosen—meaning something else to what it expresses—or the nature of the force set up in the motor is misunderstood.

A comprehensive counter E.M.F. would be generated in the motor if it was forced the opposite way to its proper motion. This force might be made so great as to entirely destroy the original current, and even to reverse it. But how a force set up in a motor, when it is urged round by a current, and which is evidently of the opposite nature to that just mentioned, can also be termed a counter electromotive force, passes my comprehension.

In fact, a very simple experiment proves at once that there is no counter E.M.F. set up at all. Putting a motor into a circuit and introducing any suitable tension-meter between the brushes as a shunt, the deflections of the instrument when the motor is stopped are simply due to the difference of potential between the brushes, depending upon the resistance of the armature coils and the proportion that resistance bears to the whole resistance of the circuit.

When the motor is allowed to run the tension-meter shows an augmentation of difference of potential between the commutator brushes, the current itself, as measured by a current-meter, necessarily falling off. If there was no friction to overcome in the motor, and no heat produced by the frequent changes of polarity in the iron of the armature, the product of current into E.M.F. as indicated by the instruments would be identical, whether the motor was running or not. The augmentation of potential when the motor is running free is a sort of storing up of force ready for immediate use, and may be likened to a weight raised and kept in suspense by manual labour. A continued exertion of energy must be employed to keep it up. This is what the motor does when it runs freely; the moment it is loaded this store of energy is drawn upon, the tension-meter shows that the difference of potential is less, the current-meter shows that the current has augmented; but the product of the two is now less than before, the difference being energy converted into work.

If you should think these few remarks worthy of a place

in the ELECTRICAL REVIEW I would have it understood that my sole object is to invite discussion on a subject so interesting and of such importance, and either be confirmed in my views or converted to others in more accordance with what we are all looking for—Truth.

I am, dear Sirs,

Yours very faithfully,

119, Toriano Avenue, N.W. MORITZ IMMISCH.

[There are some points in this letter which we shall hope to touch upon in a week or so, our correspondent having apparently misunderstood Professor Thompson in regard to E and *e*.—EDS. ELEC. REV.]

ELECTRICAL ENGINEERING CLASSES.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—Having been myself engaged in teaching experimental physics during several years, I have been much interested in the correspondence which you have printed in recent numbers of your journal on the above subject, and as I recognise in the case of the City and Guilds of London Institute as presented by your correspondents, many of the difficulties which I myself experienced, and the practical removal of which was in some measure due to my own exertions, I venture to think that some account of the system successfully practised at the Massachusetts Institute of Technology in Boston, U.S.A., where as student and instructor I passed about eight years, may be of interest and assistance to those engaged in similar work here.

The system included instruction by lecture and by laboratory practice. The lectures followed a text-book (Ganot's Physics), with a copy of which each student was obliged to provide himself, but great freedom was exercised in omitting and inserting a large amount of matter which the student was required to make notes of, and which was equally a subject for examination with the matter of the text-book. The lectures were very fully illustrated by experiments, sometimes the same which the student was afterwards to perform for himself, sometimes by others of a more delicate or costly kind which could not be intrusted to his hands, and all mathematical demonstrations were fully gone through with on the blackboard, with opportunity after each step for the students to ask questions. Students were also at liberty to remain after the lecture to get further explanations from the professor on any point which they had failed to understand. The system of note-taking at lectures was found, however, to interfere very much with a close following of the lecturer, and on this account it was afterwards almost entirely superseded by a written (heletograph copy) or printed syllabus of each lecture, which was given to each student. Once in about ten or twelve lectures a brief written examination was given, occupying perhaps 15 or 20 minutes of the lecture hour, and at the end of each term (four months), there was a full written examination, covering all the term's work, on which the student's right to remain in the class depended.

The student was not allowed to enter the laboratory until the lectures had proceeded far enough to make sure that they would always keep in advance of the laboratory practice, for it is of no use to set the student to perform experiments the principles of which he does not yet understand. In the laboratory a text-book (Pickering's Physical Manipulations), which grew out of the author's experience in the same laboratory, was followed, but with many variations and additions, which it was found necessary to provide for as in the lectures by written (heletograph) explanations, copies of which were given to the students when the experiments were assigned.

Boards were hung near the door of the laboratory, on which were fixed a number of cards bearing the names of the experiments, and where duplicate apparatus was provided duplicate cards were also placed upon the boards. Under or opposite to each of these cards was a blank space with a peg or spring clip upon which was hung a card bearing the name of the student to whom the corresponding apparatus was for the time being assigned. The board thus showed at a glance what apparatus was in use and by whom, and when a student had finished his experiment it was a very simple matter to transfer his card to any other unoccupied experiment which he had not previously done. Generally the experiments were so planned as to just comfortably occupy the time of one exercise, and the assignment of new work for the next time was made and any necessary papers given to the student before leaving, so that he might read the explanation of each experiment before coming in to perform it. In the case of several classes alternating with each other in the use of the same apparatus there was either a separate set of boards for each class or several blanks for name cards were left opposite to each experiment card, and the names belonging to each class kept in a separate column. A small book was kept in which the students' names were recorded, with the names of the experiments at the tops of as many vertical columns following that containing the students' names, and it was our practice to rapidly run through the book at the beginning of each term, and make a mark opposite each student's name in each of the columns corresponding to the experiments which he was expected to perform during the term, alternating equivalent experiments and having regard to the cases where duplicate apparatus allowed of all the students having a turn at the same one. A slightly greater amount of work was thus laid out than the student could reasonably be expected to do. This plan avoided the possibility of assigning in the hurry of the class-room a number of equivalent experiments to one student to the neglect of others, equally important, and also inspired a certain confidence in the student by giving the impression that a certain amount of care had been taken to lay out his work to the best advantage. When a student's card was changed to a new experiment the mark in the book corresponding to the experiment last done was crossed by way of record. Each student was required to keep a laboratory book, in which he noted the results of his experiments, and which he took home with him for the purpose of working them up. This book, containing results and calculations, with curves plotted on cross-section paper to show the general laws deduced, or from which these laws were deduced, was handed in at the end of the term, and taken, in connection with the results of written examinations, as a basis of the student's rank and right to remain in the class.

I have been thus minute, even at the risk of claiming more space than you can spare me, because my experience was that it was easy enough to lay out a general plan for such work that was all right on paper, but the question of its practical success or failure depended upon the conscientious working out of every detail more than upon general correctness of design.

Certain general principles, however, are essential to any great degree of success; and in conclusion, I may be excused any seeming presumption if I offer a few suggestions as the result of experience both as student and teacher. It may safely be assumed that the students who enter any purely technical class mean business; they come as a preparation for earning their daily bread, and they cannot afford to waste their time. They may therefore be depended upon, if given a fair chance, to do good and faithful work, and if by chance a few get in who show an idle or mischievous disposition, it is only common justice to the rest to turn the former out. This may most easily be done by frequent examinations, at which a certain proficiency is made an absolute condition of continuance, with perhaps an opportunity to make up allowed to those who come very near to the required standard. A single student who will not do his own thinking, or cannot, will, if allowed, consume more of his teacher's time, at the expense of his fellows, and break and derange more apparatus than a dozen good students. The only way is to give each one his fair share of attention, and if that does not enable him to keep up, drop him. As long as any student is allowed to remain, however, the utmost patience and consideration must be shown him, for if this be relaxed his ambition, what little he may have, will vanish, and he might better be dropped at once, as his continuance will tend to demoralise the rest.

The most common mistake made by lecturers is to suppose that their first duty is to cover a certain ground in a certain time; better by far go over only half as much and be sure that the student is not hurried to the point of losing his interest through sheer inability to keep up; for if a student is hurried over the ground he gets but an uncertain knowledge, which proves such a discouraging foundation to build upon that he seldom gets beyond the point where his teacher leaves him, while if he is allowed time to settle each foundation-stone firmly in its place, and get in plenty of cement

between the stones as he goes on, he will have a solid bottom to stand on that will give him courage to go on for himself.

Again, do not think it a favour to a student to admit him without proper preparation; he will only spend his time to no purpose listening to what he cannot understand; and however low the standard of admission let every part of the instruction correspond to it, being sure to start each demonstration far enough back to reach firm bottom on the student's previous knowledge, otherwise the whole structure is built upon the sand.

In the laboratory let every piece of apparatus be in perfect working order, and if it is found otherwise when a student comes to it, give him another experiment and have it repaired before the next time. Again, do not make the experiment so long that the student cannot take time to do it well, as enforced haste is a sure teacher of carelessness.

Another point: it is entirely unnecessary in teaching general principles to provide the student with delicate and costly apparatus. Provide simple, cheap, rough, but fairly correct apparatus, and enough of it for all. A student will learn the use of the Wheatstone bridge, for instance, quite as well from using an ordinary set of coils or divided metre-bridge with a five-shilling galvanometer, as from the finest set of coils and a Thomson reflector. The fact that he is unable to get more than two or three significant figures will save him time in his calculations without sacrificing any principle, and when he comes at a more advanced stage to use better instruments he will appreciate them all the better from knowing the faults of the rougher ones. Moreover, knowing that much can be done with comparatively rough instruments, he will not, in his future practice, make the too-common mistake of wasting time and money by using delicate instruments and calculations to a dozen decimal places on coarse work where very likely the nearest integer is necessarily uncertain.

Last, but not least, no laboratory instructor should have more than ten, or at most twelve, students to look after at one time; if he has it will not be fair to criticise his patience and efficiency, or want of them, too sharply; and he cannot do justice even to ten unless they are well provided with written or printed explanations, sufficient for an average understanding to follow with only an occasional lift.

In closing I wish to apologise for claiming so much of your space, and also to disclaim any intention of presuming to dictate to those who perhaps have had more experience than myself, or of aiming my remarks entirely at any particular school. Indeed, I trust that my remarks may serve quite as good a purpose in indicating to students and others what they can fairly expect of a teacher, as in helping teachers by giving them the benefit of my small experience. Much of what I have written may be quite superfluous to the experienced teachers of the City and Guilds of London Institute, whose particular case I have cited, but I doubt not there are many other classes of a similar kind about starting to whom a word in time may be of great use.

Believe me, Gentlemen,
Respectfully yours,
J. B. HENCK, Jun.

31, Queen Victoria Street, London, E.C.

THE TELEPHONE PATENTS AND COUNSEL'S OPINION *v.* JUDICIAL DECISIONS.

To the Editors of THE ELECTRICAL REVIEW.

SIRS,—I herewith send to you the sequel to the correspondence published in your excellent Review of 16th inst. The letter dated 29th November, addressed to Messrs. Gent & Co., by Messrs. Waterhouse & Winterbottom, looks very much like a wilful disobedience of the injunction granted by Mr. Justice Fry on July 22nd last, against the United Telephone Company, forbidding that company from stating that "no form of magneto telephone, and no form of transmitter in which carbon or any equivalent substance is employed."

Extract from a letter addressed to Messrs. J. T. Gent & Co. by Messrs. Waterhouse and Winterbottam, Solicitors of the United Telephone Company :—

LONDON, *9th December*, 1882.

GENTLEMEN,—We have carefully examined the instruments which you sent us, and have consulted Mr. Moulton, our counsel, on the subject. He agrees with us that both transmitter and receiver are infringements of our clients' patent rights.

LEICESTER, *December 16th*, 1882.

GENTLEMEN,—Your letter of 9th inst., addressed to Messrs. J. T. Gent & Co., of this place, has been handed to me. I take leave to reply to that part of your letter which refers to the excellent Lockwood-Bartlett receiver, and to the transmitter of Messrs. J. T. Gent & Co.

It seems that my letter of 2nd inst. addressed to you has led you to seek counsel's opinion to corroborate your own extraordinary opinion, given in total ignorance of the subject-matter.

The selection of Mr. Moulton is a very unfortunate one for your clients; and it is beyond comprehension that you should be so ignorant of your clients' patent rights, after the crucial examinations of them in the case of the United Telephone Company *v.* Harrison Cox-Walker & Co., in which case Sir William Thomson, "the most eminent electrician in the world," and other electricians—all your witnesses—so accurately described your clients' patents, added to which you have the lucid and precise description of your clients instruments and claims by Mr. Justice Fry.

Is it possible that you prefer opinions to judicial decrees ! ! !

You referred Messrs. Gent & Co. to the judgment rendered by Mr. Justice Fry, and to that by Lord M'Laren, and when you were informed that those judgments were adverse to the preposterous claims of your clients, you sought to intimidate Messrs. Gent & Co., and to prevent them from prosecuting their legitimate business by sending to them opinion of counsel, and writing about "the very heavy expenses which a litigation would involve."

The opinion of Mr. Moulton, however high he may rank as a learned barrister, or whatever reputation he may have as an *amateur* electrician, certainly is not entitled to the weight which a solemn judgment by a judge in Chancery carries with it.

Even if there were no judgment by a judge in Chancery directly at variance with the opinion of Mr. Moulton, I have a reason—and a good one too—for questioning the rightfulness of his opinion in this matter, as I have two opposite opinions given by this eminent barrister on the question of infringement of the Edison patent for a transmitter, which is the *only* valid patent for transmitters owned by your clients. I am aware that your clients purchased for a large sum Crossley's patent for a transmitter, *after* they had published to the world that the Crossley transmitter was an infringement of Edison's patent. Mr. Crossley's patent, however, according to the following opinion, seems to be invalid.

We are of opinion that the variance between the provisional and complete specification of Crossley's patent is so great that they substantially refer to two totally distinct inventions or alleged inventions, and that this would be held to be fatal to the validity of the patent, independently of any question of its novelty.

(Signed) HENRY JAMES (Attorney-General).
FARRAR HERSCHELL (Solicitor-General).
J. FLETCHER MOULTON.

March 21st, 1881.

I take leave to cite another opinion :—

We are of opinion that the Gower-Bell telephone transmitter is not an infringement of Edison's patent of 1877, as amended by the proposed disclaimer.

(Signed) HENRY JAMES (Attorney-General).
FARRAR HERSCHELL (Solicitor-General).
J. FLETCHER MOULTON.

March 21st, 1881.

The Gower-Bell transmitter has "the combination of a vibrating diaphragm and a tension-regulator," and Mr. Justice Fry, in his judgment above referred to, said, "I have concluded that Edison described the essential requisite of his invention to be the combination of a vibrating diaphragm and a tension-regulator."

This judgment was rendered in May, 1882, subsequent to the above opinion of counsel, and until that judgment be reversed by a higher tribunal it must stand as the law of the land.

Now, the same Mr. Moulton gives his opinion that a transmitter, that of Gent & Co., which has no diaphragm nor the semblance of one, is an infringement of Edison's patent, an "essential requisite" in which is a diaphragm.

With such contradictory opinions emanating from the same eminent barrister, especially when both of those opinions are directly contrary to the judgment rendered by a judge in Chancery, I do not think I am discourteous in saying that the opinion given by Mr. Moulton in this case has no weight with me, nor do I believe it can have any weight with any person.

"Tempora mutantur, et nos mutamur cum illis," may account for the discrepancy of these two opinions of this eminent barrister, for in 1881 he was counsel for the oppo-

nents of the United Telephone Company, and gave an opinion that a transmitter having "a diaphragm in combination with a tension-regulator" was *not* an infringement of Edison's patent; and now in 1882 he gives an opinion that a transmitter without a diaphragm *is* an infringement of Edison's patent, both of these opinions being at variance with the judgment of Mr. Justice Fry.

Although I make no profession to any knowledge of the practice in the Court of Chancery, it seems to me that the United Telephone Company, by their threat of prosecuting for infringement the manufacturers of instruments clearly free from infringement, according to a solemn judgment of a judge in Chancery, are guilty of a "contempt of Court." To the United Telephone Company I will merely say, "Quem Deus vult perdire priusquam dementat."

Yours truly,

W. C. BARNEY.

To the Solicitors for United Telephone Company,
1, New Court, Carey Street, Lincoln's Inn.

ANSWERS TO CORRESPONDENTS.—"A Subscriber's" letter arrived too late for insertion; he will, however, find that which he requires in our other columns.—EDS. ELEC. REV.]

NOTES.

ELECTRIC LIGHTING.—Mr. Groth, the representative in London of the Jürgensen dynamo-electric machine, writes to us conveying the information that this apparatus has recently been experimentally compared with the well-known Gramme machine in Denmark. The following is the text of Mr. Groth's communication :—

Extensive trials for the purpose of comparing the merits of the Gramme and the Jürgensen dynamo machines were recently made at Copenhagen by the Danish Government, who had appointed a special committee consisting principally of officers in the Royal Danish Artillery and engineering corps.

Two machines were ordered at the same time and on the same conditions, one from Gramme, ordered of Messrs. Sautter Lemonier & Co., Paris, and one from Mr. Jürgensen for 4,000 bec carcels each.

For driving each of the dynamos a 14-horse-power Brotherhood engine was used, and in each case the connections between the machines and the engines were exactly the same. The steam pressure was 60 lbs.

The following table will show the average of the four days' working.

	Gramme.	Jürgensen.
Revolutions per minute	475	400
Normal light	28,890	40,000
Temperature between the ring after 4 hours	30°R.	25°R.
Resistance in the dynamo in ohms... ...	0·424	0·390
Length of wire on the magnets in metres...	3,160	330

From this it will be seen that the Jürgensen dynamo gave 38 per cent. more light than the Gramme, while at the same time the Gramme dynamo required 3,160 metres on the two magnets, against the 330 used by the Jürgensen, which is a difference of about 90 per cent. in favour of the Jürgensen.

APROPOS of the running of the Edison machines during the recent foggy weather we notice letters in the *Times* of the 16th inst., on behalf of the South Eastern "Brush," and the Maxim-Weston Electric Light Companies respectively.

Mr. Offor, the Manager of the former company, says that the offices of the company and those of the Provincial "Brush" were lighted from storage batteries throughout the foggy weather without the use of a dynamo at all, except during the period of charging the cells, the lights burning with that perfect steadiness which is so important a feature in the storage system.

For the Maxim-Weston Company, Admiral Inglefield the Chairman, wrote as follows :—

"The Maxim-Weston Electric Company light Southwark-bridge, Queen-street and place, and Queen Victoria-street with 32 Weston arc lights, each giving a light equivalent to 1,400 candles. During the period alluded to in the letter under notice—namely, from Saturday afternoon till Tuesday morning, these lights were run most satisfactorily, and this without having recourse to the spare engine or dynamos, which are always ready in case of accidents.

"Pentonville-road is lit at present for 16 hours daily with 82 Maxim incandescent lamps, used in the ordinary gas lamps, which could have been also run as above, without the least difficulty, if the vestry had desired it."

AT a meeting of the Wandsworth Board of Works, the Battersea Committee recommended "That sanction be given for the full development of electric lighting operations, provided the promoters prove their ability and efficiency for the due execution of the necessary works, and that conditions are secured for protecting public and private rights before assenting to a licence or provisional order."

The recommendation was adopted.

THE Newington Vestry has received a letter from the promoters of the late indignation meeting, to which we referred in our last issue, asking the vestry to consider the opinion of the ratepayers and comply with their request by rescinding the resolution passed on November 1, or pass a fresh one whereby no further steps should be taken for the present in applying for powers to adopt the Electric Lighting Act, or take some other course of action to abandon the scheme. They begged the vestry to give the matter their serious consideration.

IN the Lambeth Vestry the surveyor reported that the Brush Electric Light Company, without applying for any consent from the vestry, had erected a cable across the Brixton and Atlantic roads. The clerk had written to the company, requiring the immediate removal of the cables, and a letter had been received from the manager of the company, regretting that the cables had been erected without the formal consent having been applied for, and that the company were prepared to abandon the present plan as soon as the company could complete arrangements for running cables below the surface. Should the company not remove the cables, the Electric Lighting Act gave the vestry full power to have the cables removed, and the committee instructed the officers of the vestry to enforce the Act if necessary.

This course was adopted, not in opposition to the electric lighting companies, but in order to assert the rights of the vestry as the road authority.

A PETITION recently presented for the winding-up of the Brush Midland Electric Light and Power Company (Limited) has been withdrawn, the company paying costs.

THE Edison electric light seems likely to meet with success in Australia, where it is being introduced under the auspices of Major Flood Page, the late manager of the Sydenham Crystal Palace. The aptitude of the gallant major for his post is very *naïvely* put by the *Melbourne Herald*, of November 7th, in the following terms :—

The Edison Electric Light Company did a very wise thing when they engaged Major Flood Page as their general manager, for that gentleman undoubtedly understands exactly how to place the plans of the company before the public in an expeditious and effective manner. Last night he gave a dinner-party to about fifty gentlemen in the Café Gunsler, &c., &c.

During the evening the town clerk expressed himself to the effect that he hoped before twelve months had passed the streets of Melbourne would be illuminated by means of electricity.

Major Flood Page gave a description of what had been accomplished in England and America by the Edison system.

WE also notice that the offices of the *Sydney Morning Herald* have been fitted up with Edison lamps under the direction of Mr. H. H. Kingsbury, the representative of Mr. Edison in New South Wales.

THE Pullman train to Brighton is now fitted with 40, instead of 18, incandescent lamps, owing to the employment of the new Faure-Sellon-Volckmar accumulator supplied by the Electrical Power Storage Company. This company, by virtue of arrangements referred to in another column, has now the sole right in England for these storage batteries. In the first instance 70 Faure accumulators (original pattern) were required for the 18 lamps, whereas there are

now only 30 Faure-Sellon-Volckmar cells supplying 40 lights, their total weight being considerably less than half those formerly employed.

"IT'S an ill wind that blaws naebody good," was doubtless the thought of Mr. Akester the other afternoon, as the Glasgow merchant hurried into his office and asked an immediate installation of the electric light, as his gas supply was completely stopped by the severe frost. The request was complied with, and by 5 p.m. the shop was brilliantly lighted up. The occurrence has already brought business and is expected to lead to more shortly.

AN action was raised before Lord Adam, in the Court of Session, Edinburgh, on Wednesday last, by James Wylie Guild, C.A., Glasgow, against William Plenderleith Hope, merchant, Leith, and the Scottish Brush Electric Light and Power Company. Pursuer was engaged to get up a new company, and had proceeded a certain length when the defenders took the matter out of his hands, and gave it to Messrs. Panmure, Garden, & Co., London; and he now sues defenders for alleged breach of contract proportionate to the work done before it was taken out of his hands. Intimation of the action was ordered to be made to Mr. Molleson, the liquidator of the Electric Company, which is now in liquidation.

THE Local Boards of Withington, Moss Side, Rusholme, and Stretford have conferred together and decided not to proceed with their applications for Provisional Orders, considering the experimental stage of electric lighting.

ABOUT a month ago the Sheffield Town Council decided to apply for a Provisional Order. This decision was, however, only arrived at by the casting vote of the Mayor. The order has been prepared, and a retainer given to the town clerk to take such proceedings as may be necessary for obtaining the requisite authority from the Board of Trade and certain expenses incurred. At the Town Council meeting last week the subject of electric lighting was once more brought forward. An attempt to prevent payment of the expenses was defeated by a majority of one, but on the minutes of the committee being submitted for confirmation they were rejected by a majority of one. The Mayor, who entertains a very strong feeling in favour of the town having the electric light in its own hands, expressed his willingness to find the expenses out of his own pocket. On Monday last the committee agreed to proceed with the application for a Provisional Order for lighting the centre of the town.

THE CATALOGUE OF THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—On glancing over the catalogue of additions to the library of the Society of Telegraph Engineers, appended to the report of the librarian, we notice, under the pseudonym of "Christopher Caustic, M.D., LL.D., A.S.S.," a work treating on electrical quackery, or, as the author terms it, "Galvanising Trumpery," published in 1803. If there was occasion for writing on this subject eighty years ago, how much more could be written at the present time, when the Patent Office is crowded with so-called inventions of a more or less ridiculous character. We are glad to see that the library of the society is being enriched and completed by the addition of the older works on the subject, as well as the more modern ones.

NEW COMPANY REGISTERED.

GENERAL ELECTRIC LIGHT AND POWER COMPANY OF RUSSIA (LIMITED).—Capital £500,000, in £1 shares. Objects: To carry into effect an agreement between Alexis Joseph Rousseau and the Swan United Electric Light Company, Limited. Signatories (with one share each): R. E. Crompton (electric light engineer), Mansion House Buildings; G. W. Batt, 20, Great Winchester Street; G. F. Rogers (telegraph engineer), 5, Great Winchester Street; H. T. Nell, 29, Oakfield Road, Clapton; A. J. Rousseau (telegraph engineer), St. Petersburg; E. Fox, Milwall; S. Gray, 4, Bramerton Street, Chelsea; P. Belloc, Forest Gate, E. The signatories are to appoint the first directors. Qualification: 250 A shares. Registered 18th inst., by Ashurst, Morris, and Crisp, 6, Old Jewry.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

ORIENTAL TELEPHONE COMPANY (LIMITED).—The return of this company, made up to 3rd of May, was filed 8th of May. The nominal capital is £300,000, in £1 shares. The number of shares taken is 274,580. The full amount has been called upon the 75,000 vendors shares, and 10s. upon the ordinary shares. The calls paid amount to £174,842 10s. leaving £157 10s. unpaid. £100 has also been paid upon 800 shares forfeited. Registered office, 3, Great Winchester Street, E.C.

* LONDON AND GLOBE TELEPHONE AND MAINTENANCE COMPANY (LIMITED).—The return of this company, made up to 2nd of June, was filed on 17th of June. The nominal capital is £600,000, in £10 shares. The only shares *recorded* as taken up are 7, and these are considered to be fully paid. Registered office, 31, Queen Victoria Street.

PHŒNIX MEMNON (LIMITED).—The return of this company, made up to 1st of September, was filed on 13th of September. The nominal capital is £1,600, in £8 shares, the whole of which have been taken up. £4 per share has been called, the calls paid amounting to £272 and unpaid to £528. Registered office, Baker's Lane, Buckden, Huntingdon.

* The company proceeded to allotment after the filing of this return.

CITY NOTES, REPORTS, MEETINGS, &c.

THE FAURE ELECTRIC ACCUMULATOR COMPANY, LIMITED.

AN extraordinary general meeting of the shareholders of the Faure Electric Accumulator Company, Limited, was held at the Cannon Street Hotel, on Monday last, under the presidency of Sir A. J. Otway, M.P., chairman of the company, for the purpose of ratifying, or otherwise, the following agreements which had been provisionally entered into:—1st, An agreement between the Faure Electric Accumulator Company, Limited, of the one part, and the Electrical Power Storage Company, Limited, of the other part, for the sale by the Faure Company to the said Storage Company of the remaining interest of the Faure Company in the patents of Faure, Sellon, and Volckmar in England, on the terms and conditions mentioned in the said agreement. 2nd, An agreement between the Société la Force et la Lumière, of the one part, and the Faure Electric Accumulator Company, Limited, of the other part, for the purchase by the Faure Company of the rights and interests of the Société la Force et la Lumière in the French Electrical Power Storage Company, Limited, on the terms contained in the said agreement. 3rd, An agreement between the Faure Electric Accumulator Company, Limited, of the one part, and the French Electrical Power Storage Company, Limited, of the other part, for the sale by the Faure Company to the said French company of the property in Paris belonging to the Faure Company, and providing for the Faure Company subscribing for shares in the said French company, as provided in the said agreement.

Mr. Herbert Canning, secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, you have heard the notice read convening the meeting, which, I need scarcely say, is one of considerable importance to all of you who are interested in the Faure Company. Now, certain contracts have been provisionally signed by the board of the Faure Company. I say provisionally, because these contracts have no validity whatever until you should ratify and approve of them. These contracts have been drawn in pursuance of the policy indicated to you on previous occasions by M. Phillipart: on which two occasions you unanimously gave your adhesion. On the second occasion I felt bound to tell you that the board, not concurring in the mode of procedure, would be unable to continue their functions as administrators of the company, and that they would ask to be relieved from the office which they now hold, and that others should be appointed in their place, and I expressed the opinion that those to fill their places should be those who were in entire accord with M. Phillipart in the policy he was about to carry out; and as the work of the company would henceforth be carried out in France, I thought it right that they should be French and not English directors. M. Phillipart accordingly entered into certain arrangements with which I had no concern, which he has, I think, explained in a clear manner to you. Certain arrangements were made which were limited as to time, had been made by M. Phillipart, and the consequence was that the board, unless their arrangements were to fall through entirely, and the prospects which appeared to M. Phillipart were to be dispelled it was necessary that the agreements should be provisionally signed by the board. Hence, Gentlemen, that which may appear an inconsistency, but which is really not so in point of fact, is perhaps to be found on the part of some of you who hear me, that the signature of some members of the board is given to contracts which they themselves do not approve. It was because time was the essence of this matter, and under the conditions that they should be entirely a provisional character. Now, I am not here to express an opinion on the contracts themselves; they will be read by our solicitor, and M. Phillipart will address you thereon. Nor am I about to enlarge upon the feelings of the board with regard to them. A mode of carrying on a business commends itself often to one

person, but is not so favourably spoken of by another. One condition, Gentlemen, I think it essential to make. I adverted to it on the last occasion. It is necessary that I should mention it. I said I would not leave my place at the board until I was certain that that which I considered a sort of honourable engagement which had taken place towards certain shareholders had been fulfilled, or until the means were provided by the day named. I allude to the supplying of every shareholder who has applied for the same, one fully paid-up share with regard to 2 shares he holds with £2 paid thereon. It has not been possible to divide these shares at the present moment so as to give to every shareholder his one share fully paid-up for the two which he resigns; but a certificate for the aggregate amount necessary to do that will be lodged with myself and our solicitor for the carrying out of this operation. I understand that at latest on the 2nd January next M. Phillipart will be prepared with all the certificates divisible amongst the shareholders who applied for them I also understand that a letter will be sent to all the shareholders with regard to that matter. Well, when that is done, I can say I shall consider our business as administrators of this company terminates. We have endeavoured to do our best; we have had as little agreeable a time and as anxious a time as it is possible for any body of gentlemen to have. It is always difficult for gentlemen who have conducted business on certain lines suddenly to be called upon to conduct that business on other lines. We have endeavoured to popularise the accumulator and make it known in this city. My own hopes are that it will be a success, and I am sorry, perhaps, that it will not be in England that its great success will be attained; but there are conditions in France, concerning the price of gas and the cost of coal, which will make it a more profitable concern in France than in England. We wanted to form an industrial company, that was our sole wish; but as the business is now transferred to another country, our usefulness ceases. And we now seek the earliest moment at which we can to retire from the place of confidence in which you have placed us. I think that cannot take place at once; there are some necessary proceedings. M. Phillipart will remain, and it will be necessary to nominate one other, and these, forming a quorum, will be able to find some satisfactory colleagues to carry on the business of the company. I shall be glad if any gentleman present will interrogate us on any matter on which he may wish to have information. We have nothing whatever to conceal, and therefore we should like to have this opportunity of answering any gentleman's questions concerning the company, or the way in which it has been carried on, or any remarks which he has to make.

M. Phillipart said: The contracts which were to be that day submitted for the approval of the shareholders, were only provisionally signed on Thursday last. He thought they really ought, and might have been signed sooner and without the reservation of their approval, for they only carried out the programme which the shareholders unanimously approved on the 6th November last, and the particulars of which the shareholders received with enthusiasm at their last meeting on the fourth of this month. He could not now enter into all the details of those contracts, for it would take up too much time, and would, besides, be unwise in their common interests. But I wish again to touch upon the salient points, in order that you may seize the advantages we shall derive therefrom. By those contracts the Storage Company returned to the Faure Company their 20,000 fully paid-up ordinary shares, which were sold to them by the agreements of the 6th and 7th July last; and the Société la Force et la Lumière surrenders as well 50,000 deferred shares. On the other hand the Faure ceded to the Storage Company, definitely and entirely, the interest it retained in the Sellon and Volckmar patents for the United Kingdom. By the second and third contracts the Faure Company obtained possession of about 92 per cent. of the Faure, Sellon, and Volckmar patents for France and the French colonies. In virtue of these contracts that interest would be represented by preference and ordinary shares of the French Electric Power Storage Company; which company possessed the exclusive right for the exportation of those batteries. The intention of the French company was to sell some of those shares and to employ the proceeds of such sales in the purchase of Faure, Sellon, and Volckmar patents for other portions of the continent, reserving the balance either to distribute to the shareholders, in whole or in part, as dividends, or to be retained by the French company, as might be most advantageous to them. After the fulfilment of those contracts, and with the 40,000 shares of the French company fully paid up, the following would be their financial position:—Of the 80,000 ordinary shares in their company, 47,000 only would be issued, leaving 33,000 unissued. Their assets would consist of an interest representing about 92 per cent. of the Faure, Sellon, and Volckmar patents for France and the French colonies, and they would further have available a sum exceeding £100,000. He trusted that the shareholders would be pleased with that. After the execution of those contracts, the French company expected to be able to pay, in the course of the month of January, a dividend at the rate of 10 per cent. per annum from the date of issue upon the £2 paid on their 40,000 ordinary shares. He might add that he had cogent reasons for stating that during the month of February next the French company would be able to declare a further dividend of at least £4 per share, and he hoped for still greater things. It was, of course, understood that the execution of those contracts assured the fulfilment on the due day of the engagement taken by the "Société la Force et la Lumière," with those among the shareholders of the Faure who had accepted its offer. Their chairman and his colleagues deemed it right to retain their seats until this engagement was fulfilled. He did not wish to under-rate the value of the work of his colleagues, but he wished to take this opportunity of stating that the "Société la Force et la Lumière" never had any idea of departing from its undertaking. On the contrary, it was pleased that so many of the Faure Company's shareholders had accepted its proposal; that it was of opinion that it had done good business, which it would not relinquish on any account. The interests of the shareholders who transferred their shares would be as well looked after by the French company as by others. Certainly they were not infallible, and might make mistakes, but if that were the case the shareholders had the satisfaction of knowing that they themselves would be the greatest sufferers. Perhaps he might be allowed to once again touch upon the value of the invention the company possessed, and to enter into a few details in connection therewith. On the 6th November last he told them that the accumulator was as great a necessity for electricity as was the gasometer for gas. Secondly, that the Faure, Sellon, and Volckmar accumulator, was so far the only practical and economical accumulator. Thirdly, that they had the best reasons for believing that it would not be superseded. He did not believe that any one would even now attempt to controvert the two first assertions, and in support thereof he was pleased to be able to tell them that the company which had purchased the Donnithorne accumulator, of which they had heard so much, had entirely abandoned it and had applied to the Storage Company to furnish it with all the accumulators it requires. Indeed the Storage Company cannot nearly execute all the orders it receives, although producing 250 tons of accumulators monthly. As to the third, it would be said that no one could put a stop to the progress of science. The question to be solved was the extent of progress which was required to attain perfection; and consequently the sooner they attained to perfection the less room would there be for improvements, and therefore the less they would have to fear. To arrive at the relative value of the invention three things had to be considered. First, prime cost; second, cost of maintenance; thirdly, yield. Now, what progress still remained to be made under these heads? Prime cost. Their accumulators were now made exclusively of plates of lead, cast with holes in them, into which holes was put red lead or oxide of lead. These plates, after having been formed by the passage of electric current lasting 100 or more hours, were placed in a wooden box, lined with sheet-lead, and separated from each other by india-rubber bands. The first cost of the material was £15 or £16 a ton, and that of the labour about an equal amount. What could be discovered simpler and more economical? Maintenance. Half the plates composing the accumulator are called positive and half negative. Experience proves that the negative plates did not wear out in working. The positive plates only after a greater or less number of months' work become unapt for work, owing to the entire peroxidation of the plate. Thus the maintenance of the batteries renders replacing of one half of the plates necessary every year as a most liberal estimate. But this replacing simply implied a question of labour, seeing that it was only necessary to grind up these peroxidised plates, and with this ground peroxide to fill up the holes in the new lead plates, unless indeed, which was probable, this peroxide was sold at a much higher price than the lead or red lead, in which case the maintenance of accumulators would become a source of profit instead of a source of loss. It was clear, therefore, that both from the point of view of cost of maintenance, and from the point of view of prime cost there was little room for improvement. Yield. Eighteen months ago Sir William Thomson had certified for the first Faure batteries which were subjected to experiment by him had given a yield exceeding 75 per cent. Six months later their eminent electrical engineers, Messrs. Perry and Ayrton, had certified a yield of over 80 per cent., and he was satisfied that to-day, with a good system of charging and discharging, they could obtain a yield exceeding 85 per cent. Such being the case, was he not justified in telling them that they need not fear more from the future than from the past, and that the progress they had made during the last twelve months was a guarantee of that which they should continue to make? Further he did not lose sight of the fact that any improvements made by others would belong to them and would remain useless in the hands of the inventor so long as their patents were in force. They saw, therefore, on what a solid basis their confidence in the future of the company was founded. In conclusion he wished to say to them that they had given up all idea of liquidating the company, as they had found that there would be considerable legal difficulties to be encountered and overcome, and moreover, after mature consideration, they were of opinion that their company, which was the first in the field, could maintain its position and organise and direct others.

Professor Ayrton, in speaking on the mechanical construction of the accumulators of the present time, said that the Faure accumulator of to-day was enormously in advance of what Planté had done before. The accumulator originally suffered from three defects. An accumulator was like a cellar of coals with a small door: it would contain only a certain amount of coal, which they could get out but slowly. What they had been doing lately at Millwall and at Paris was to try and make the cellar hold much more coal for the size, and give it out more quickly. During the last year great strides had been made in this respect, and the accumulators now submitted were twice as good as those which were submitted a year ago, and would give out twice as quickly—which was a very important point. It did not so much matter when the thing was stationary, but when they came to the locomotion or propelling of tramcars, tricycles, and so on, then the giving out of electrical energy very, very quickly was of the utmost importance. Only quite recently they were in the habit of having very heavy "horses," and yet they would only go slowly. They had now light "horses," which proceeded swiftly, but who require filling frequently. They had propelled a tricycle by means of a Sellon accumulator a mile in 8¾ minutes. Then with regard to propelling boats, they had also made great strides during the past 12 months, as they would now give out quickly without polarisation. He went a journey a few weeks ago in the electric boat, and he went again on Saturday last, and the result then was quite as satisfactory as before. They travelled at the rate of seven knots against the tide, and 10 or 11 with it. He had tested an accumulator which weighed 130 lbs., which gave a horse-power for three quarters of an hour. And he had tested one on Saturday which weighed altogether 75 lbs., but which gave out a horse-power for one hour. Thus, with only half the weight, they got as much storage capacity;

therefore the cells must have contained twice as much energy with the same dead weight, and which were able to give out the electric energy quickly, which was of immense importance. The accumulators of the present day were, looked at from an electrical point of view, twice as good as they were a year ago. Moreover, the cells were so constructed now that they could take the plates away and put a new plate in its place.

In answer to a question, Professor Ayrton said that an electrically driven tricycle differed in the eye of the law from one driven by steam, which latter was virtually a "locomotive."

Mr. D. Thomas said: When they met at the first meeting to inaugurate the new policy the tone of the chairman's speech was eminently in favour of the new policy being adopted, and that influenced the meeting much. He should like to know whether anything had occurred to cause him to alter his opinion.

The Chairman thought that a very proper question. He had no desire to say anything unfavourable to the policy of M. Phillipart. He had spoken of his scheme in general terms, but where he had been unable to agree with him was as to the procedure by which he had carried out that policy. He (the chairman) had never been mixed up with any financial matters. He had great confidence in M. Phillipart as a business man, and he thought these matters in France would be of benefit to the shareholders.

Sir Charles Clifford (deputy chairman of the company) said the present board took the position they did believing they were going to carry out one of the most wonderful productions of the present day, and that they were going to develop an accumulator which they thought was in their own hands, and was likely to be productive of wonderful events in the world. The board determined to do their best to forward the interest of the shareholders and the interest of the world at large; for he thought the interests of the accumulator was very much wrapped up in the interests of the world. That state of things went on for a time, when the board found that two-thirds of the shares had got into the hands of one person and his particular friends. The possession thus obtained over the company would naturally prevent the board from carrying out their schemes and intentions, if they so happened to differ from him and his friends. And moreover, when those interests were to be identified with French and not English interests, and moreover those schemes were not intended so much for the development by the board itself of the wonderful powers of the accumulator, as for the working of the accumulator financially, whereby he would gain probably a greater dividend by the shareholders leaving others to the development of the principle. The board came to the unanimous determination that, though they were willing to work for the benefit of the shareholders, and for the benefit of science, they were not willing to work for the interests of a small party. They thought they should resign in favour of those who knew more about the schemes likely to be introduced than they did themselves. He had no doubt that M. Phillipart was able to carry out the interests of the shareholders. He thought M. Phillipart was right in acting as he had, believing that the interests of the shareholders would be secured by the schemes he proposed to adopt. The board had now resigned the trust that the shareholders had reposed in them entirely into the hands of others over whom they would have no control. The shareholders had heard from M. Phillipart the pleasant prospects before them; he hoped those prospects would be realised, but if that were not realised he begged shareholders not to reflect upon the late directors, but to lay all the blame or praise, as the case might be, upon the directors who were coming to them. Let the present board, he asked, go away with a clean sheet, so far as their relations with the shareholders were concerned, and he was satisfied.

A Shareholder asked whether in the event of these hopes being realised and those large dividends spoken of being paid, those gentlemen who did not consent to the transfer or the conversion of their shares would be allowed to participate.

The Chairman: Certainly.

M. Phillipart asked to say a few words in reply to Sir Charles Clifford's observations. It was entirely a mistake, he said, to think the French company were going to enter into this as a question of finance, if by finance they meant speculation. From the report which had been read to them, and the explanations of Professor Ayrton, their profits would come from the use and development of the accumulator and not from speculation. He wished the shareholders to understand that it was their simple intention to proceed in this matter as an industrial scheme, and only as an industrial scheme.

Mr. D. Thomas said he thought he understood when first the matter came before them, that this was to cease to be an industrial concern and to be worked as a financial scheme for bringing out of other companies.

M. Phillipart said in speaking of other companies, he spoke to a great extent of France and its size, and that this company would be shareholders in the company which owned the right to manufacture the accumulators for France, and to supply France they would want companies formed in large towns, who would take licences from this company, and carry on the use of electricity in towns and provide accumulators as they may be required.

Mr. Auckland asked whether the whole of the companies with which they would be associated would be limited companies.

The Solicitor replied that they would be limited companies formed under English law, of which this company received an interest of 92 per cent.

A Shareholder asked whether it was true that there was a litigation going on against the directors of this company.

The Chairman said he was certainly threatened with proceedings. The fact was that some people said we had made an agreement with them which we did not carry out. The board ordered some accumulators, but did not care to take them, some question arising as to whether they were good. However, they would be taken now, and the price would be paid according to the contract price agreed upon.

A Shareholder remarked that on the last occasion they were told the scheme was an extension of the Faure Company into France. He asked if that was so?

The Solicitor replied in the affirmative; but said that at the same time the shareholders were told that they would take their profits from a company working in France.

Mr. D. Thomas inquired whether the Faure Company's directors would hold their meetings in France.

The Solicitor said no. The directors would meet in England as hitherto.

Mr. Custance then proposed the ratification of the agreements, and that the directors be authorised by this meeting to complete and carry the same into effect, which was seconded by Mr. Albert Golding.

The Chairman having put the resolution, which was carried unanimously, said he would say no more than that the entire responsibility of that act rested entirely with the meeting. He hoped the new scheme would be thoroughly successful. Having ratified those agreements the contracts now became valid. Sir Charles Clifford had pointed out that the present board were not responsible for any of the statements that came from other parties and not from the present board, let that be clearly understood.

Mr. D. Thomas asked who would be the gentlemen to form the new board?

The Chairman said that M. Phillipart remained; that they had one vacancy on the board, according to the articles of association, and that they proposed to nominate a French gentleman, of whom satisfactory references could be given. He and M. Phillipart would form a quorum, and thus be able to form a board.

M. Phillipart said in the month of February next the shareholders would be called together to approve the nomination of the directors, who would be chosen to form a board.

The Chairman, in answer to a question, said that he had no intention to part with his interest in the company; he originally purchased 100 shares in this company; he had exchanged them for 50 fully paid-up shares.

Sir Charles Clifford said all the directors had done the same thing.

Mr. Staples proposed a vote of thanks to the board of directors and to the chairman. The board had most arduous duties to perform, and had at all times been anxious to do what was best for the proprietors. He thought they deserved great credit for having steered through the shoals and quicksands which arose from time to time. And the least the shareholders could do, was to give them a very hearty vote of thanks for what they had done. At the same time, if he might be allowed to couple the name of M. Phillipart with his proposal, he should be glad to do so. He felt that they were all much indebted to M. Phillipart, much indebted indeed to him, for opening to them so large and apparently profitable a future.

Mr. Turner seconded the proposition, which was then put to the meeting and carried unanimously.

The Chairman thanked the shareholders very sincely for the vote of thanks. It was not more than true to say that they had been in most difficult positions, having to reconcile a very great conflict of ideas. Every one of them had tried to do what he considered best in the interests of the company. Of course M. Phillipart, being the largest proprietor, said no one else had so great an interest in the company as himself, and therefore what advice he gave must be for his own interest.

M. Phillipart, in responding, said that the only way in which he could thank them was to earn for them the dividend he had promised.

The proceedings then terminated.

EASTERN EXTENSION, AUSTRALASIA, AND CHINA.—An interim dividend has been declared for quarter ending 30th September, of 2s. 6d. per share, payable on the 16th January. The coupon on the 5 per cent. Australian Government Subsidy Debentures, due 1st January, will be paid on that date at Messrs. Barclay & Co.'s.

EASTERN TELEGRAPH.—A dividend of 3s. per share on the preference shares, less income-tax, for the quarter ending 31st December, 1882, will be paid on the 15th January, 1883; and an interim dividend of 2s. 6d. per share for the quarter ended 30th September, with a bonus of 1s. per share for the half-year on the ordinary shares (both free of income-tax), will be paid on the same date, equal (with the previous interim dividend of 2s. 6d. per share) to a distribution for the six months at the rate of 6 per cent. per annum.

GREAT NORTHERN TELEGRAPH.—A half-yearly interim dividend has been declared at the rate of 5 per cent. per annum, payable on the 1st January, 1883, by Messrs. C. I. Hambro & Son, 72, Old Broad Street, E.C.

SWAN UNITED ELECTRIC LIGHT COMPANY (LIMITED).—This company has made a call of 10s. per share, payable on the 9th of January, 1883. This call is made in order to carry out some important new installations now in hand. The call letters were posted this evening.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY.—The secretary informs us that the coupons due on December 31st next on this company's debentures, will be paid on the 30th inst. on presentation at the bank, by Messrs. Barclay, Bevan, and Co. Coupons must be left three clear days for examination.

TRAFFIC RECEIPTS.

The Great Northern Telegraph Company. The traffic receipts in November, 1882, were £20,440; from January 1st to November 30th, 1882, £223,720, and in the corresponding months of 1881, £218,291; and in 1880, £221,922.

The Western and Brazilian Telegraph Company. The traffic receipts for the week ending December 1st, 1882, were £2,302; for the week ending December 8th, £2,625, and for the week ending December 15th, 1882, to £2,732, after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company (Limited).

West India and Panama Telegraph Company (Limited). The estimated traffic receipts for the half-month ended December 15th are £2,832, as compared with £2,476 in the corresponding period of 1881. The September receipts, estimated at £3,376, realised £3,479.